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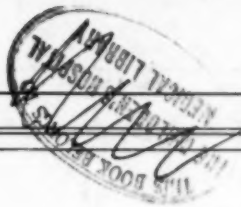

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RADIOLOGY

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TO CLINICAL RADIOLOGY AND
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Vol. 41 DECEMBER 1943 No. 6

Symposium on Injuries of the Head, Chest, and Back
Head Injuries[1]

HARRY E. MOCK, M.D.

Chicago, Ill.

The Radiological Society of North America is to be congratulated on the comprehensive program it has prepared for its annual meeting. The subject matter of the majority of these papers is exceedingly timely in this period of war. I feel highly honored to act as chairman of this symposium devoted to injuries of the head, chest, and back.

IN INTRODUCING himself the author wishes to stress the fact that he is not a brain surgeon. Rather, he is a general surgeon who, for thirty years, has had considerable experience in surgery of trauma. Long before there were any neurosurgeons in Chicago, the victims of skull fractures and brain injuries were treated by general surgeons. Because of the nature of his practice, the author had treated several hundred serious head injuries before any specially trained neurosurgeon had entered this locality. He had started already on his hobby of collecting skull fractures. He has continued to ride this hobby until today he has records of over seven thousand proved skull fractures. Of this number, approximately five hundred have been treated by him personally.

It has been estimated that the annual crop of head injuries throughout the United States approaches six hundred thousand. Approximately one-third of these are skull fractures. The records of the 7,031 skull fractures which have been collected and studied by the author furnish a cross section of the nation as to the principal etiological factors. Motor-driven vehicles were responsible for 50 per cent of these skull fractures, falls for 26.8 per cent, and blows for 10.3 per cent. The other 13 per cent were due to miscellaneous causes. It must be recognized at once that such potential etiological factors are scattered all over the land. Every hamlet, village, and city has its quota of craniocerebral injuries.

The majority of deaths from skull fractures—and the same is true of brain injuries without skull fractures—occur in the first twenty-four hours following the injury. In the author's series of cases 64 per cent of those dying died within the first twenty-four hours, and 60 per cent of these first-day deaths occurred in the six hours immediately following the injury. In consecutive cases surveyed from nineteen hospitals, 47 to 56 per cent of the total deaths were likewise first-day fatalities.

When one realizes that skull fractures occur all over the land—on the farm, in small communities as well as in the large centers—and when one considers the high preponderance of deaths in the first twenty-

[1] Presented before the Radiological Society of North America at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

TABLE I: SURVEY OF 6,262 CONSECUTIVE CASES OF PROVED SKULL FRACTURE

Survey	Total Number of Cases	Total Deaths	Range of Death Rates	Average Mortality
First: 1928–1935	3,156	1,098	25–49%	35%
Second: 1935–1940	3,106	896	17–42%	28%
Total	6,262	1,994		
Average improvement in death rate				7%

four hours, it must be recognized that head injuries will always be a problem for the general physician and surgeon. The full responsibility of saving the lives of many of these patients rests solely upon the shoulders of the medical man who first receives the case. The type of management instituted in the first six to twenty-four hours spells life or death for many of these victims.

No one recognizes better than the roentgenologist that the presence or absence of a skull fracture is of little moment in the management of head injuries and in reducing the mortality rate. It is the brain injury and not the crack in the skull that dictates the type of management and that influences the mortality rate. Many a head injury without a skull fracture will produce serious damage to the brain. Conversely, many cases give little evidence of brain injury other than a mild concussion. Few skull fractures occur, however—in the author's experience about 6 per cent—without very definite evidence of brain injury. It is for this reason that *proved skull fracture* has been taken as the measuring-rod of comparable seriousness in collecting the records of the more than seven thousand cases referred to above.

In 1940, with the assistance of Drs. John L. Lindquist, S. R. Snead, F. E. Sarver, and Harry E. Mock, Jr., the author surveyed the consecutive records from 1935 to 1940 of twelve hospitals in Illinois, Wisconsin, and Indiana, with the consent of their staffs. In addition, survey sheets from the records of twenty-six other hospitals, representing every section of the country, were filled in by a number of surgeons. This nation-wide survey, the second the author had made of skull fracture cases, netted 3,106 consecutive records. The hospitals were labeled "A" to "S," two or three small hospitals in the same community being grouped together. Table I shows the number of cases studied in each survey and the results of management as gauged by the mortality rates. A definite improvement is apparent in the second survey.

Standards of observation and of good, average, and poor treatment were established in order to compare the management and results thereof among the 3,106 collected cases of the second survey. Each individual case record from each hospital was graded according to these standards. The average of the grades for the total series of cases in each hospital determined the management group to which the hospital was assigned. Table II shows the points on which each management group was graded. The mortality rate found in each group justified these grades.

Further analysis of the nineteen hospitals that treated these 3,106 consecutive skull fractures during a five-year period revealed that the injuries were of equal seriousness judged by the relative proportion of linear, basal, and combined fractures. The staffs of four of these hospitals so managed 323 cases that the mortality rates ranged from 17 to 21 per cent. The staffs of five so managed 2,033 cases that the mortality rates were 23 to 29 per cent. But the staffs of ten hospitals rendered such poor management in 750 cases that death rates mounted to 30 to 42 per cent.

"Consecutive cases—not picked cases—of equal seriousness and treated in the average run of hospitals in the United States—hospitals where your wife or mine would be taken for treatment if injured while making an automobile tour of the country! Why this wide divergence in results?"[2]

[2] MOCK, HARRY E.: Management of Skull Fractures and Brain Injuries. J. A. M. A. **120:** 501, Oct. 17, 1942.

TABLE II: GROUPING OF HOSPITALS ACCORDING TO GOOD, AVERAGE, AND POOR MANAGEMENT

Number of Cases and Points Determining Grading	Good A to D	Average E to I	Poor J to S
Number of Consecutive Skull Fractures	323	2,033	750
Mortality Rates	17 to 21%	23 to 29%	30 to 42%
Observation: Average Grade	85%	75%	54%
Treatment: Average Grade	82%	60%	35%
Shock Rules Observed	85%	70%	45%
Dehydration, when Used, was Adequate	90%	70%	38%
Spinal Tap, when Indicated, Done Early (1st 24 hours)	78%	50%	20%
Spinal Fluid Drainage Sufficient (20 to 70 c.c.)	80%	45%	18%
Operative Judgment	78%	80%	50%

OBSERVATION

If in every instance of severe craniocerebral injury one could lift the cranial cap and actually see the pathologic changes in the brain and in its blood and cerebrospinal fluid circulations, the management of the case would be simplified and many controversial problems concerning treatment would be solved immediately. But the surgeon viewing the unconscious patient with a severe head injury must depend on the signs and symptoms, rarely stationary, more often showing changes in variety and intensity, if he is to approach even an approximate diagnosis of the pathologic changes inside that skull.

The changeability of the signs and symptoms and the importance of recognizing and interpreting many of these changes furnish the strongest argument for close observation and charting the course. The value of close observation is reflected in the mortality rates of the good, average, and poor management groups in Table II. The grade of 85 per cent for observation in the good management group means that with few exceptions every case record had the blood pressure, pulse, respiration, and temperature charted at least every two hours and in many instances as often as every thirty minutes. This "charting of the course" indicates that the surgeons were in control of their cases at all times. The observation grade of 54 per cent in the poor management group represents a far different situation—blood pressure often neglected, and pulse, respiration, and temperature charted only two or three times a day. Such charting indicates poor navigation.

X-RAY EXAMINATION

Every head injury case should have an x-ray examination, but never in the presence of shock, deep coma, or wild delirium. Years ago the author made a poster embodying this slogan and this has hung in x-ray departments in various hospitals throughout the land. Exceptions to this rule may occur when badly depressed comminuted fractures are suspected or when an extradural hemorrhage is suspected and the surgeon is anxious to know if the fracture line crosses the middle meningeal artery. In such instances a portable apparatus should be used rather than subject the patient to the added insult of moving him to the x-ray laboratory and turning him in the multiple positions necessary for a comprehensive study of the skull. The question may well be asked: "Why x-ray the remaining cases if the crack in the skull is of no moment?" The medicolegal aspect is obvious but certainly not the chief reason, as stressed by many authors. If the late roentgenogram shows a fractured skull, the wise surgeon will recognize the potentialities of greater brain damage and will keep the patient quiet in bed and under close observation for a longer period than if he had a head injury without fracture. Furthermore, the x-ray may reveal a depression that was not suspected on palpating the skull or it may show the presence of an aerocele. There are plenty of reasons why an x-ray study should be made, but few reasons why it should be made during the period when it is adding insult to injury.

From 1933 cases from our second survey in which the record indicated the time of

TABLE III: DEATH RATE CORRELATED WITH TIME OF X-RAY EXAMINATION IN RELATION TO INJURY

	X-Rayed	First 6 Hours	Deaths	6–24 Hours	Deaths	2nd Day	Deaths	Later	Deaths
Good Management	238	53 (22%)	3.8%	74 (31%)	12.2%	19 (8%)	10.5%	92 (39%)	4.3%
Average Management	1,151	188 (22%)	12.2%	337 (30%)	6.2%	190 (16%)	4.7%	436 (38%)	6.2%
Poor Management	544	181 (33%)	19.3%	215 (39%)	13.0%	50 (9.8%)	20.0%	98 (18%)	7.1%

taking roentgenograms, Table III was developed. This table shows the increased tendency to x-ray the skull immediately or in the first few hours in the poor management group as compared with the average and good management groups. It also shows the increased mortality rate of early as compared with later roentgen examinations.

denced by the 7 per cent improvement in mortality rates in the second of our two nation-wide surveys. The above indictment is warranted if it will stimulate more of us to reduce the high mortality rate from brain injuries.

The management which will produce better results and lower mortality rates in brain injuries is epitomized in Table V.

TABLE IV: RESULTS OF X-RAY EXAMINATION

	Total Cases	Deaths	Total X-Rayed	X-Ray Positive	X-Ray Negative	No X-Ray
Good Management	323	19.7%	238(73.6%)	220(92.4%)	18(7.6%)	85(26.3%)
Average Management	1,747	29.9%	1,151(65.9%)	928(80.0%)	223(20.0%)	596(34.1%)
Poor Management	750	33.3%	544(72.7%)	489(89.0%)	56(11.0%)	205(27.3%)
Totals	2,820		1,933(68.6%)	1,637(84.7%)	297(15.3%)	886(31.4%)

Table IV indicates the total number of patients x-rayed in each management group and the number of positive and negative x-ray findings. In the cases not examined roentgenographically and those with negative films, proof of skull fracture was indicated in the record by bleeding from the orifices or as shown at operation or autopsy.

TREATMENT

After conscientiously analyzing the 3,106 consecutive proved skull fracture cases collected, and especially the 750 consecutive cases treated in the *poor management group*, the author is convinced that 50 per cent of those dying in the hospitals where the poorest handling of skull fractures was apparent might have been saved by closer observation of each individual case and by adherence to well established rules concerning the care of these patients. All of us in the profession are slowly learning these rules of management and are making better use of them, as evi-

TABLE V: MANAGEMENT WHICH GIVES IMPROVED RESULTS

1. Treat cerebral shock first.
2. Avoid adding insult to injury.
3. Chart course hourly. Live with the patient.
4. Blood transfusion for persistent shock or severe associated injuries.
5. Oxygen early for persistent unconsciousness, cerebral anoxia, threatened respiratory failure, or associated chest injuries.
6. Postural drainage or aspiration.
7. Adequate dehydration; spinal drainage; operation—*each when and if indicated by signs and symptoms.*
8. Avoid overdehydration. Maintain fluid balance without pushing fluids. Prolonged dehydration may be the cause of death.
9. Do spinal puncture early when indicated. Drain adequate amount of fluid. Early operation seldom indicated.
10. Maintain nutrition. Feed by stomach tube if necessary.
11. Avoid oversedation. Seldom, if ever, use morphine.
12. Consider the patient, not the family or the surgeon's convenience.

Time will not permit greater detail concerning the indications and methods for

dehydration, spinal drainage, and operations in skull fractures and brain injuries. Those who are interested will find a more detailed account of management in the *Journal of the American Medical Association*, Oct. 17, 1942. The point to be emphasized here is that the high mortality rate from skull fractures can be reduced by every physician and surgeon who treats these cases. The author's mortality rate twelve and ten years ago varied from 20 to 21 per cent. He has reduced it to 16.7 per cent. In Table II he has graded nineteen hospitals scattered from New Hampshire to Texas, and from Washington to Florida, including small rural hospitals, private hospitals in medium-sized and large cities, and a few large county hospitals, in which the number of consecutive skull fracture cases treated during this five-year period varied from 20 to 1,500. The mortality rate in the best of these hospitals was 17 per cent, whereas the hospital showing the poorest results had a death rate of 42 per cent. Four hospitals made up the *good management group*, with an average mortality rate of 19 per cent. Five hospitals constituted the *average management group*, with an average death rate of 25 per cent. Ten hospitals belonged to the *poor management group*, with an average mortality of 38 per cent. Remember, these were consecutive cases—not picked cases—of equal seriousness and treated in the average run of hospitals in the United States. Ask yourself the questions: "Into which hospital would I want my wife or child taken for treatment if injured while making an auto tour of the country?" "Why does the staff of one hospital save 83 per cent of its skull fracture cases while another hospital, receiving approximately the same proportion of linear, combined, and basal skull fractures, with approximately the same proportion of associated injuries, saves only 58 per cent?" The answer to this last question is graphically shown in Table VI.

TABLE VI: WHAT CAUSES DEATH IN SKULL FRACTURES?

PATHOLOGICAL (10 to 12% inevitable)

1. Cerebral shock.
2. Massive brain lesions.
3. Small hemorrhages in vital centers.
4. Serious associated injuries.
5. Complicating diseases.

MISMANAGEMENT (5 to 50% preventable)

1. Failure to treat shock first.
2. Failure to observe and "chart the course."
3. A "hit-and-miss" type of dehydration.
4. Overdehydration and starvation.
5. Too few or too late spinal punctures.
6. Too few, too many, and too early operations.
7. Oversedation.

122 South Michigan Ave.
Chicago, Ill.

Some Considerations Concerning the Roentgen Diagnosis of Skull Fractures[1]

J. C. KENNING, M.D., with IVOR D. HARRIS, M.D.
Detroit, Mich.

IN THE PAST eighteen years at the Detroit Receiving Hospital we have examined roentgenographically over 50,000 skulls to determine the extent of injury. Of this number, about 9,000 have shown fractures. We feel, therefore, that some suggestions concerning the diagnosis of skull fractures can be made.

To give the examination the widest application, we have utilized a simplified technic of four projections for all patients having signs, symptoms, or history of skull injury. Right and left lateral, frontal, and occipital views are obtained. The use of the smallest possible focal spot, Bucky diaphragm, and precision in technic are considered essential. It is not until we find that a questionable line exists, or that a probable fracture has not been demonstrated, that additional films are taken. In many of our cases, injury is so trivial that more exhaustive studies would be too time-consuming and expensive for routine use. In those cases where additional films are required they are taken with greater precision and with less distress to the patient due to the longer lapse of time. Their specific purpose is to show the suspected area in the greatest detail and with the least superimposition. Ginsburg has given an excellent review of the possibilities and limitations of the various special views. By following the course just outlined, we have found that our accuracy of diagnosis has been at a very good level and much time and money have been saved. Exhausting initial examination may do harm to the patient.

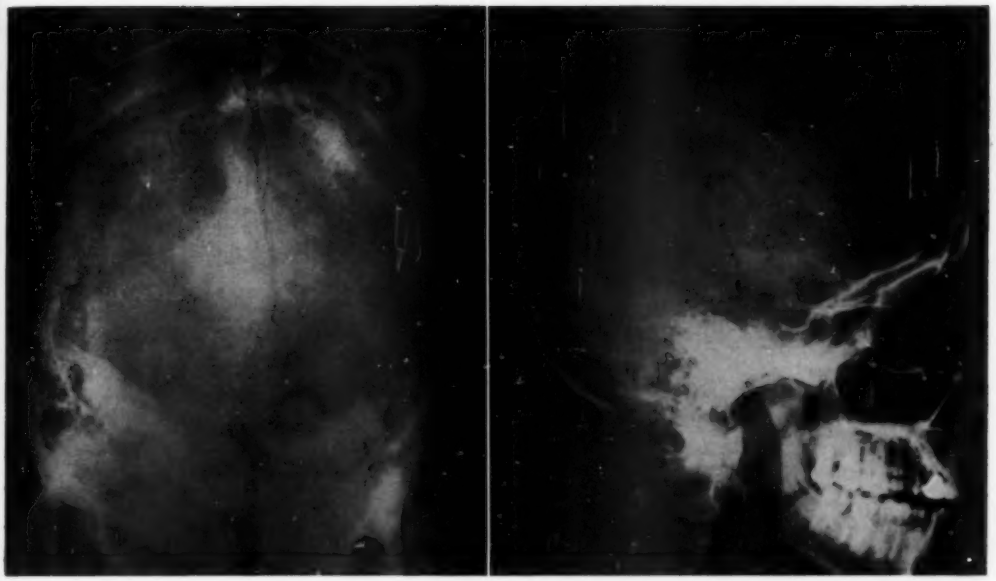
We have arbitrarily divided our skull fractures into three groups: (1) those in the anterior third, including all of the frontal area; (2) those in the middle third, including the parietal, sphenoidal, temporal, and mastoid areas; (3) those in the posterior third, including the occipital bone. An analysis has shown that 26.8 per cent of all fractures occur in the anterior third, 45.3 per cent in the middle third, and 27.9 per cent in the posterior third. This includes all of the various types: linear, stellate, comminuted, depressed, and diastatic. These figures have been substantiated by Rand, Rendich, Ehrenpreis, Stewart, and others. At our clinic the mortality is seen to parallel this incidence, being reasonably low in the frontal and occipital regions, and increasing rapidly as the fracture line extends laterally and downward toward the mastoid. Unfortunately, too, fractures in this latter region are the most difficult to detect.

The establishment of a proper diagnosis is, of course, the first consideration. Not only is the presence of a fracture line of importance, but also its extent and the possibility of involvement which may contribute to complications. These matters are deserving of most careful deliberation and co-operation between the roentgenologist and the attending physician.

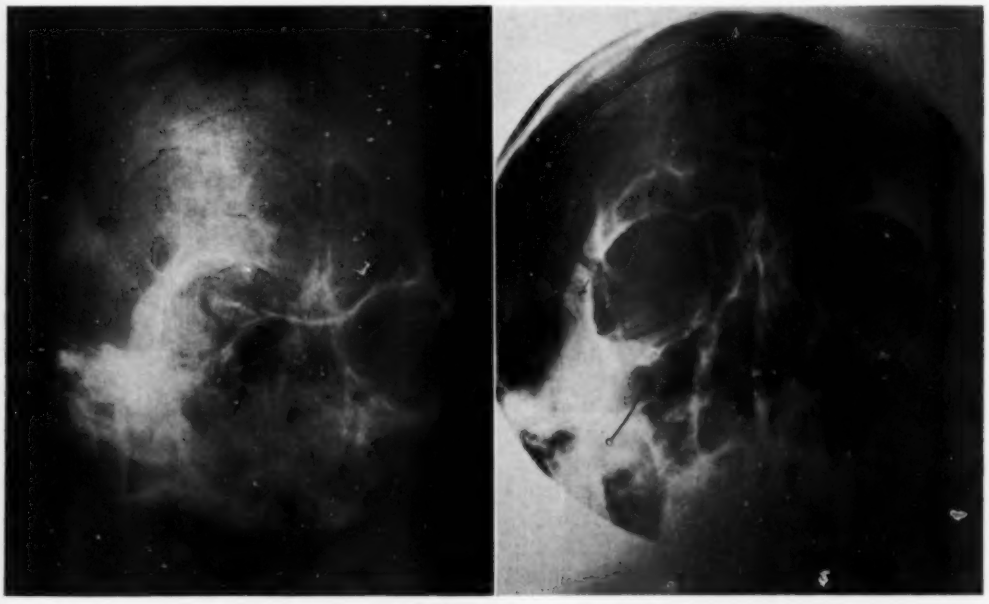
Linear fractures are the chief source of worry in differential diagnosis. Any sharply etched linear shadow which shows a dissolution of the continuity of the fine osseous structure may represent a fracture. As is well known, differentiation must be made from suture lines, diploic markings, vascular grooves, and artifacts. Linear fractures are generally darker in appearance than any of the other markings. Their course is usually not that characteristic of vascular markings, but may be so, (Figs. 1 and 2).[2] Vascular markings radi-

[1] Presented, as part of the Symposium on Injuries of the Head, Chest, and Back, before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

[2] All examples shown were proved either at operation or autopsy.



Figs. 1 and 2. Showing close resemblance roentgenographically between vascular grooves and fractures of skull. Fig. 1 (left) shows a branching line of decreased density closely simulating a fracture of the occiput. Autopsy revealed no evidence of fracture but showed prominent vascular grooves. Fig. 2 (right) shows a fracture of the middle third of the skull simulating a vascular groove.



Figs. 3 and 4. Routine orbital view showing no involvement of the orbit and antral view revealing marked extent of fractures involving the orbit. The patient became blind three weeks following injury.

Figs. 5 and 6. Fig. 5 (above) shows fracture of the left temporal area extending into the sphenoid sinus. Note the similarity to the spheno-temporal suture line. Fig. 6 (below) shows the normal spheno-parietal suture.

ate upward and posteriorly in an ever divergent path. Fracture lines, if they do branch, soon converge, whereas vascular markings never do this. The differentiation between branching fractures and wormian bones is sometimes more closely drawn.

In the study of fractures of the anterior third, the inconstant median metopic suture of the frontal bone, irregularities in the roof of the sphenoid sinus and petrous ridge, wormian bodies, and variations in the suture lines between the inner and outer tables frequently confuse the picture. This is particularly true in patients who have peculiarly shaped skulls. In cases of doubt the vertico-submental projection, occlusional films, and routine non-Bucky

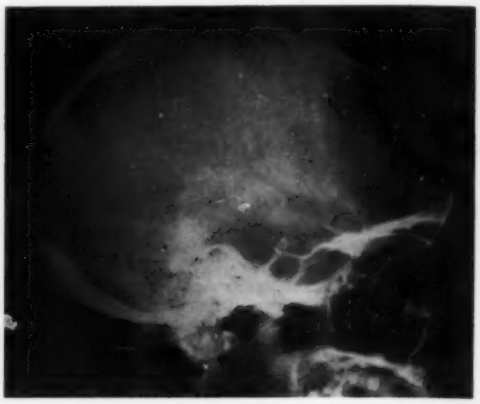
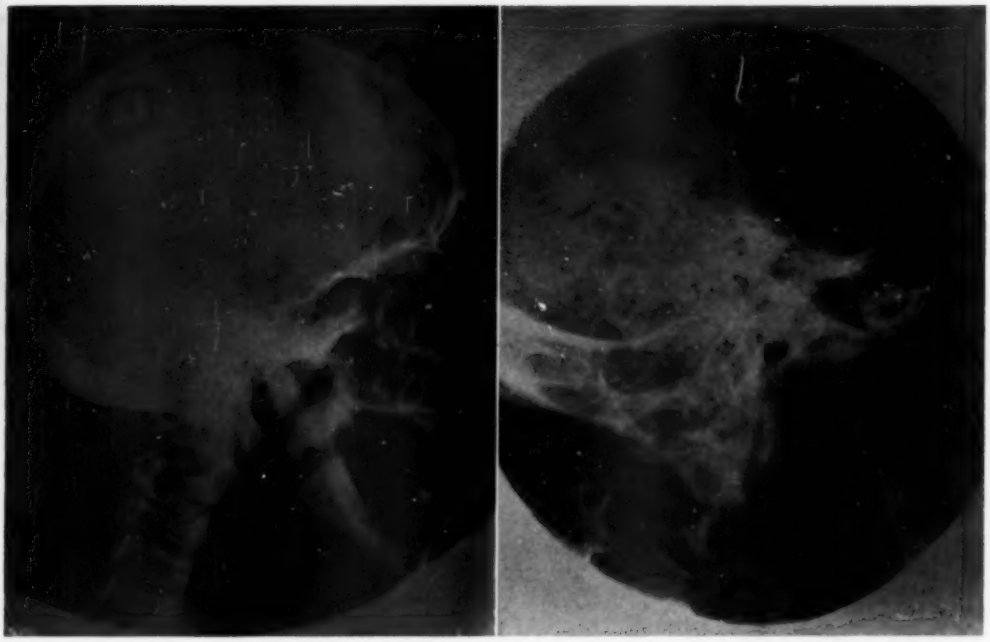


Fig. 7. Fracture of parietal and sphenoid bones and sphenoid sinus.

sinus films clarify the issue. Fractures of the face and sinuses should warn the roentgenologist to be on guard for possible fracture of the base of the skull.

Of the complicating fractures in the anterior third, we are all aware of the involvement of the cribriform plate of the ethmoid with resultant leakage of the cerebrospinal fluid and the danger of meningitis and abscess. It is sometimes difficult to follow the fracture into the ethmoid, but every possible care should be taken to avoid missing such a communication, so that the patient may be properly safeguarded. Involvement of the frontal sinuses presents two possibilities. If only the anterior wall is fractured, the dangers are not grave, since scalp infection and osteomyelitis are the most likely complications. If the posterior wall is disturbed, however, we have the same dangers as are present in fractures of the cribriform. Films taken at a tangent are often necessary to distinguish between anterior and posterior wall fractures. Of 120 patients with fracture of the frontal sinus observed recently in a short period of time, with an average hospitalization of seventeen days, 116 showed complete recovery. Aerocele occurred in 3 cases. One case gave complete ventricular visualization. Orbital fractures may be of great significance if trauma is of sufficient severity to produce involvement of the optic foramen. Special



Figs. 8 and 9. Routine left lateral view of skull showing no evidence of fracture and mastoid view of same patient revealing definite evidence of fracture of left mastoid.

orbital views should be made in any case of immediate or delayed impairment of vision (Figs. 3 and 4).

In the middle third (Figs. 5 and 6) there may be difficulty in distinguishing between fracture and the normal linear sphenoparietal suture marking. Oftentimes the latter is short, sharp, and of such distinction that it may be considered of traumatic origin if not carefully analyzed. Other sutures in this vicinity, the frontosphenoidal and the lower end of the coronal, may assume similar characteristics. In the temporal bone the groove of the middle meningeal artery may be finely marked and assume the appearance of fracture. When the differential diagnosis is established, considerable help can be given the surgeon if it is made clear that the fracture involves this groove. Early operative care for hemorrhage in such cases has saved lives.

The line of relative decreased density caused by the greater wing of the sphenoid may be mistaken for a fracture. This line is a quarter of an inch in front of the anterior clinoid and extends for a distance of three-quarters of an inch. Fracture lines extending through the greater wing of the sphenoid into the body may involve the sphenoidal sinus (Fig. 7). On numerous occasions we have demonstrated fracture lines running through the floor of the sella turcica. The dangers are again evident.

The squamosal, as well as the parietomastoid and mastoid occipital sutures will at one time or another be designated as fractures unless unlimited care is taken. The ovoid character of the cranium causes a marked variation in constancy of visualization of supposedly identical sutures bilaterally. The absence of repeated demonstration of the line does not rule out fracture, since a slightly different angle of projection may cause its obliteration.

The many types of fracture of the mastoid are deserving of more elaborate consideration than can be given here. In every case giving a history of aural hemorrhage bilateral routine lateral mastoid

Fig. 10. Extension of fracture from right temporal region across the base of the skull, involving the ethmoid and mastoid on the opposite side.

views are obtained (Figs. 8 and 9). Mastoid fractures have been classified as transverse and longitudinal. The longitudinal fractures generally involve the auditory meatus and tympanic cavity. It is rare that the membrane remains intact in such injuries. More often than is ever suspected, the fracture lines will be a combination of both types, and extend across the base of the skull toward the opposite side (Fig. 10). Such fractures, particularly the transverse element, almost always involve a break in the capsule. The mortality is increased as the mastoid shows greater involvement. The association of deafness and vestibular phenomena are too often neglected. Deafness may be the result of hemorrhage into the middle ear or edema of the nerve secondary to injury. It may result in a permanent defect. Semicircular canal involvement often produces profound and protracted symptoms.

Mastoiditis as a complication may be seen early or late. With the involvement of the capsule, bony non-union is almost invariably the result. We have several cases to substantiate this. One fracture was demonstrable sixteen years and another twenty years after the original accident. These defects are a constant source of danger to the patients (Figs. 11 and 12). Other complications subsequent to fracture in the middle third, to mention only a few, are: diabetes insipidus, hypotension, facial paralysis, amnesia, aphasia, arteriovenous fistula, and injury to the abducens.

Fig. 11. Fracture of mastoid with non-union. The patient suffered injury sixteen years previously with no complications; he entered the hospital recently with acute meningitis which had its source in the fractured mastoid.

In fractures of the posterior third, or occipital bone, complicating features are at a minimum and involvement of the foramen magnum at our clinic has not seemed to be of too great consequence. The projection of a metopic frontal suture, the occipital condylar articulations, and the lambdoid suture markings sometimes confuse the picture, particularly in young patients. The accurate estimation of diastatic fracture is a matter of judgment and experience here and elsewhere.

We would say a word concerning the healing of fractures. A review of the literature reveals no constant agreement. In the skull, as elsewhere in the body, the ordinary linear fracture in the child will heal readily, generally in from four to twelve months; in adults eight months to two years are required. Comminuted and depressed fractures heal with a rapidity dependent upon their extent and the amount of "reduction." Gaping and diastatic fractures, particularly over the dome of the skull, are slow to heal. Some have been detected as late as eight years subsequent to injury. Occipital fractures heal slowly only because of the thickness of the bone. In our experience, fractures of the mastoid, in most cases where a follow-up has been possible, have shown bony non-union, and the mortality, both immediate and remote, has been found to depend upon the extent of fracture.

The time interval for union has become most important medicolegally since the advent of the automobile and will become even more so subsequent to the present highly motorized war. Vance states that an old linear fracture can be differentiated from a new one after eight months' time. In general, we would agree, except in some cases of mastoid fracture and in the base of the skull, where even the most exacting examination has failed to reveal an absolute difference.

Fig. 12. Fracture of temporal region. The paitent was first seen in November 1942 with injury over the temporal region but no evidence of fracture in routine views. On readmission, in June 1943, with injury to the jaw and a stab wound in the abdomen, examination revealed the evidence of an old fracture involving the mastoid. Review of the earlier films showed evidence of fracture by retrospect only. This illustrates the importance of mastoid involvement.

SUMMARY

Over 50,000 cases of skull injury have been examined at the Detroit Receiving Hospital.

The initial roentgen examination includes four routine views, with subsequent views of suspected areas. The importance of these special studies is emphasized.

Skull fractures are divided arbitrarily into three groups, depending upon the area of involvement. In this series 45.3 per cent were in the middle area, or temporomastoid region. Fractures in this region are more easily missed and complications are more serious than elsewhere in the skull. Some of the difficulties of diagnosis are discussed and the importance of the time interval for healing with reference to differential diagnosis and the medicolegal aspects is suggested.

We wish to extend our thanks to Dr. E. S. Gurdjian for his help and criticism.

1536 David Whitney Bldg.
Detroit, Mich.

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The Management of Jaw Fractures[1]

FREDERICK W. MERRIFIELD, M.D., D.D.S.
Chicago, Ill.

THE MOST frequently fractured of the facial bones is the mandible. Pathological fractures, the indirect result of disease, are not uncommon, but the majority of mandible fractures are traumatic. The advent of the high-speed automobile has changed our ideas of the etiology of fractures of the facial bones but, with rubber and gas rationing and reduced speeds, this hazard will be largely eliminated, at least for the duration, and fists and falls will probably take first place as causes of mandible fractures in civilian practice. War injuries, unfortunately, will be of severe type, taxing the skill and ingenuity of the surgeon.

Fractures of the mandible may be partial, involving the alveolar processes or individual teeth, or they may be complete and of the same varieties as fractures of other bones—single, double, or comminuted.

Single fractures occur most frequently, predominating over double fractures in the ratio of two to one. They are located at the angle or the mental foramen. Of the double fractures, those occurring at the angle on one side and mental foramen on the other are by far the most common (about 75 per cent). Fractures in the region of the symphysis menti or condyle are less frequent. The sites of predilection, in the order of their frequency, are the angle, mental foramen, molar region, symphysis, condyle, and coronoid process.

Areas of anatomic weakness in the mandible determine the location of a fracture. In children with unerupted teeth the cuspid region is most frequently the site of fracture. Fractures of the body of the mandible when teeth are present are invariably compound.

The diagnosis of fracture of the jaw is usually not difficult. There is a history of injury and the patient often presents a characteristic appearance; the head is carefully held, with the mouth open and an increased flow of saliva and drooling because of pain elicited by the muscular pull on fragments and a natural disinclination to swallow. There is some swelling; localized pain is variable but may be severe. Difficulty in opening or closing the jaws may be due to disinclination or to the displacement of fragments. Because of this displacement, the alignment of the jaws may be disturbed, with abnormal occlusion of the teeth. Anesthesia of the lower lip and gums may be discovered.

Unnecessary movement of parts should be avoided, but crepitus may be elicited and a false point of motion felt. X-ray examination is the best means of determining the extent of injury. It is possible to examine the entire mandible from the temporo-mandibular joint on one side, around the jaw, to the joint on the other side, and this examination should be made in every case.

TREATMENT OF FRACTURE OF THE MANDIBLE

The objectives of treatment are the care of the injured soft tissues to prevent or minimize infection and the reduction of fragments to normal position, which usually results in the restoration of occlusion of the teeth. The restoration of the normal tooth occlusion is of the greatest importance in gaining a good functional result. The teeth will act as landmarks for successful reduction and will provide points of fixation for wires or other appliances which may be indicated. Thorough cleansing of the mouth and teeth should be done before any attempt is made to reduce fractures. This entails the irri-

[1] Presented, as part of the Symposium on Injuries of the Head, Chest, and Back, before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

gation of lacerations and the removal of calculus from the teeth in order to make as clean a field as possible. The use of a suction tube with a small nozzle will be a great aid in cleansing wounds of debris and blood clots, in effect a minor débridement.

Broken teeth, teeth in the line of fracture, partly avulsed teeth, and fragments of bone in comminuted areas should be regarded with concern and suspicion. At the same time, it is imperative that no viable bone be removed and, after study of the problem involved in retaining the fragments in position, that no tooth be removed that may be of aid in fixation. Many fractures have been complicated by the unconsidered removal of every loose or apparently useless tooth.

Often teeth may be retained, with distinct advantage, even though some degree of infection must be overcome. It is a well known fact that repair goes on in the mandible even where severe infection exists (osteomyelitis), provided adequate drainage is maintained. The patient should be encouraged in mouth irrigation or the use of mouth washes.

When the soft tissues have been cared for, attention is directed to reduction and fixation. Before the days of Hippocrates fractured jaws were treated by ligatures and splints. Dr. Thomas L. Gilmer, in 1887, used the sound jaw as a splint and articulated the teeth of the fractured fragments with the teeth of the sound jaw by means of wires. With some modifications, this method is in use today and still is the simplest and most generally satisfactory way by which a fractured jaw can be immobilized after reduction. A variation of this method is to ligate arch bars of fairly stout wire (16 gauge) to teeth in both jaws and connect them firmly with wire ligatures or by means of elastic bands. More recently there has been a trend toward the use of pins, nails, or screws. These methods are sound and of great value, especially in the treatment of multiple fractures, refractory fragments, and edentulous jaws. Open reduction and direct wiring or plating are to be avoided.

The methods outlined above should be used under strict asepsis and with a knowledge of the osteology of the structures involved. The advantages of this form of treatment are that the mandible is free to function, mouth hygiene is improved, feeding is simplified, and the comfort of the patient is greater. With the observance of strict surgical asepsis, watchful aftercare, and good technic, there appear to be no disadvantages. We have never had a patient who complained seriously of the ligation of the two jaws. The older methods of intermaxillary wiring are often used as secondary aids and will not be discarded.

Splints are undoubtedly of great value in the treatment of some cases, particularly where there is loss of bone. To support jaws where bone grafting is indicated their use is imperative. The construction of splints, however, is time-consuming and they are useless unless carefully and expertly made. Impressions of the jaws are often difficult to obtain and if they are not accurate the results are not good. The setting of the splints may tax the resources of the surgeon when he attempts to assemble the fragments to the splint. We have made splints and have had to discard them for this reason. Perhaps our technic was not good, but we do know that 80 per cent at least of all mandibular fractures can be successfully treated by the simpler methods. In an excellent book by Ivy and Curtis the use of splints is discussed very fairly.

FRACTURES OF THE MAXILLA AND FACIAL BONES

Automobile accidents have increased the incidence of maxillary fractures. They occur on the farm as a result of the greater use of machinery and from the kicks of animals. Accidents in industrial plants, also, frequently result in upper jaw and facial injuries. One of our chief concerns at present is the care of such injuries suffered by the armed forces. While maxillary fractures have a lower incidence than those of the mandible, they often present more

acute problems in treatment, since they may be related to head injuries and fracture with displacement of one or all of the facial bones.

Ivy and Curtis classify maxillary fractures as follows: (1) Fracture of the alveolar process alone; (2) unilateral fractures across the facial aspect, above the roots of the teeth and through the hard palate; (3) bilateral horizontal fractures above the palate and below the orbital plates; (4) extensive comminution and crushing of the upper part of the maxillae, complicated by fracture of the nasal and other bones.

Blair *et al.* in discussing early local care of face injuries say of maxillary fracture: "Considered in relation to fractures, the term maxilla includes all the bones of the face with the exception of the frontal bones and the mandible—all together, including the lachrymal and the lateral masses of the ethmoid, vomer and parts of the sphenoid, forming one integral mass, in which fracture lines disregard anatomic boundaries. In treatment, a distinction exists between the more solid tooth-bearing part of the maxilla and the more articulate framework of the superstructure."

The success in treatment of these injuries is in direct proportion to the early and proper care the patient receives. It is not enough to succeed in realigning the jaws and restoring the occlusion of the teeth. Displaced fragments of bone, unrecognized or ignored and not returned to normal position, make for deformity, which may be difficult or impossible to correct later.

In treating fractures of the maxillary bones and related structures, the method to be used is best determined after careful radiographic and clinical examination has been made. The more accurate and painstaking the details of the plan evolved, the more likely is a proper solution of the problem to be obtained. Casts made of the displaced fragments may be of great aid in diagnosis and facilitate the making of appliances which may be necessary.

Simple intermaxillary or interdental wiring may be sufficient in some types of maxillary fracture. Fractures of the alveolar process and unilateral fractures of the palate can be treated in this way. Spreading mid-line fractures of either upper or lower jaw have been satisfactorily treated by us with the simple wire arch suggested by Risdon.

Complete horizontal fracture of the maxillary bones may show very slight or gross displacement. In the former case, a rubber dam bandage stretched to a plaster head cap from beneath the mandible will sometimes restore occlusion and hold the maxillary fragments securely in place. In the more severe displacements a reversed Gunning splint may be used, but we have had more satisfaction from the method of Tederspiel, who passes wires through the cheeks. These wires pass from arch bars within the mouth to outrigging incorporated in a plaster head cap. No scars are left if the wires are placed carefully, and they cause no tissue reaction.

The most serious maxillary fractures are those in which crushing and comminution of the upper part of the face are associated with complete horizontal fracture. The maxillae are separated from the base of the skull, which may also be fractured. Supportive treatment is indicated and there should be no haste in reduction or repositioning of fragments, since infections are common and meningitis a real danger. During the time of waiting, provision for drainage may be made and normal saline irrigation used frequently to cleanse the tissues. Fixation is accomplished by rigid connections between a reversed Gunning splint and a plaster head cap, adjusted to restore the full vertical dimension of the face.

Fractures of the maxillae are often associated with fracture and gross displacement of the nasal bones and of the zygoma and zygomatic arch. These fractures are common in automobile accidents and are always the result of severe blows. Diagnosis is usually to be made on the basis of disturbed facial contours and digital examination, but swelling may mask the extent of the injury. Radiographic examination is very valuable.

Except in the case of ethmoid involvement, when delay in manipulation or reduction is imperative to minimize danger of meningitis, nasal fractures should be reduced as soon as possible. For good reason, however, a delay of two weeks can be allowed.

The impacted fragments should be released and the reduction of all fragments made, the nose being molded to form by intranasal elevation and external pressure with the fingers and thumb. Insertion of the rubber-protected blades of a large Kelly forceps in either nostril will allow of internal manipulation. The septum must be replaced and retained in its relation to the vomer. If the nasal bones are spread they must be replaced to restore the proper space relation at the inner canthus. This procedure and the care of nasal mucosal tears are of great importance.

Light intranasal packs and firm external splints are usually sufficient for retention. It may, however, be necessary to provide support for the nose, in which event an internal splint attached to the upper teeth may be advisable. To hold the fragments forward it may be necessary to pass wires through the nasal bones, secured around external pads.

Fractures of the zygoma and zygomatic arch are relatively uncommon, but always present problems of treatment. Displacement may occur in any conceivable direction and may be accompanied by extreme swelling, disturbance of facial contours, interference with mandibular movements, crushing of the antrum and laceration of the mucous lining, facial anesthesia, diplopia, ecchymosis, and emphysema. Reduction is done as early as possible following injury, and means of using leverage to restore displaced fragments are employed. Many methods are in use, that of Gillies of London being perhaps the most effective and popular. He passes a suitable instrument from an incision within the hair line, between the temporal fascia and the temporal muscle, to the area beneath the zygomatic arch and proceeds to move and adjust the fragments in position. In the event that the orbital rim is fractured, with an accompanying displacement of the orbital floor, it may be necessary to open the antrum and pack to maintain this structure in position. When facial structures are reduced satisfactorily, it is not often necessary to wire or otherwise immobilize fragments, as there is no muscle pull to affect them.

Feeding is an important consideration in the care of patients with jaw fractures. Generally speaking, the diet should be nourishing and of adequate vitamin content, and will vary from liquid to soft, depending upon the method of immobilization used. The caloric requirement will be between 2,000 and 3,000. It may be said that any well balanced diet may be made available to these patients by proper and suitable preparation, which means that, in addition to actual liquid nourishment, meats must be finely ground, vegetables and fruits pureed, soups and broths strained. In fact, all food prescribed must be capable of easy passage through a feeding tube by easy suction. Spoon feeding may be employed. Occasionally it is necessary to use nasal feeding.

122 South Michigan Ave.
Chicago, Ill.

The Roentgenologic Diagnosis of Chest Injuries[1]

J. PAUL BENNETT, S.M., M.D.
Chicago, Ill.

Introduction

Before continuing this symposium with a discussion of chest injuries by Doctor Bennett, I wish to refer once more to the 3,106 consecutive skull fracture records collected in my second nation-wide survey. In studying the injuries associated with skull fractures it was apparent that chest injuries were the most serious. The association of multiple fractures of the ribs with skull fractures resulted in an appalling increase in mortality rates. The death rate increased from an average of 19 per cent to 28.5 per cent in the good management group; from 25 per cent to 37 per cent in the average management group; and from 34 per cent to 65.5 per cent in the poor management group.

Chest injuries, always serious, are especially so when associated with brain injuries.

HARRY E. MOCK

THE ROENTGENOLOGIC findings in chest injuries range from very slight to exceedingly extensive, depending largely upon the nature of the traumatizing agent and upon its force, penetration, and course. In some cases there may be merely evidence of soft tissue swelling, with no sign of fracture or of intrathoracic damage. In other cases one or more fractured ribs may be found, without evidence of deeper injury. The importance, in the study of ribs, of having a number of views is well known, as a fracture may be completely obscured when the beam is tangential to the curve of the involved rib. This is particularly prone to occur in the axillary regions. It is well to bear in mind that when the injury is anterior there may be a fracture of a cartilage which will not be revealed on the roentgenogram unless the cartilage is calcified. Such cases are difficult to prove but I have seen instances where there was reason to believe that such a lesion was present, or, in some cases, separation at a costochondral junction. In other cases, there may be a fracture of the sternum. Lateral or oblique views are required to demonstrate this. The necessity of such views is indicated by the physical findings. The normal separation between the manubrium and the corpus of the sternum should, of course, not be confused with a fracture. If care is not taken, occasional irregular calcification in the cartilages protruding anterior to the sternum in the lateral view may also be confusing.

In study of the routine chest film, observation of the osseous structures should never be omitted. Occasionally, in a patient giving a history of pain in the chest but denying trauma, a roentgenogram will reveal one or more fractured ribs. At times even a fractured dorsal vertebra may be suspected from the chest film. A localized decrease of the vertebral aspect of the intercostal spaces—even where the vertebral outlines are indiscernible—may be the first clue to a fracture of a dorsal vertebra. An anteroposterior and lateral view of the spine centering over this area may then reveal the compression fracture.

Varying degrees of subcutaneous emphysema may be observed on the film (Figs. 1 and 6). At times this may be the only evidence of a perforated lung. If the perforation is slight, there may be no demonstration of a pneumothorax, especially in certain phases of respiration, and yet considerable air may be present in

[1] From the Department of Roentgenology, Cook County Hospital, Chicago. Presented, as part of the Symposium on Injuries of the Head, Chest, and Back, before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

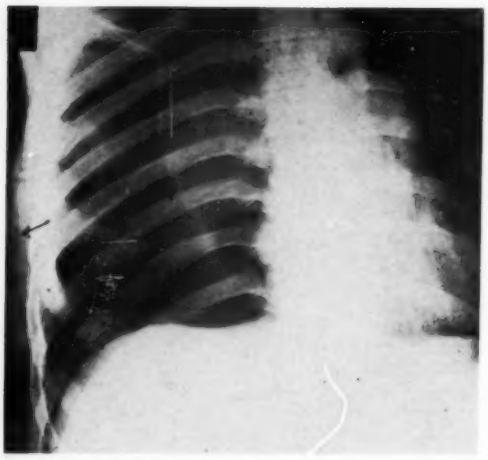


Fig. 1. Case of fractured ribs, extensive pneumothorax, and subcutaneous emphysema.

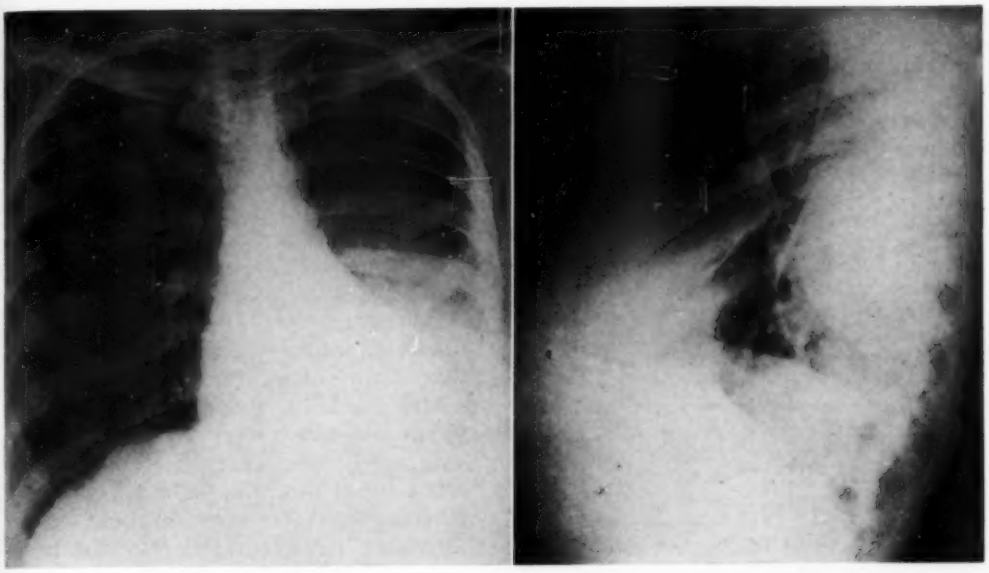
the soft tissues. This is particularly true of stab wounds, where ordinarily there is no evidence of associated rib fracture. Usually, when the pulmonary trauma is below the level of the clavicle, the subcutaneous air, if moderate in amount, is located unilaterally—on the traumatized side only. If the injury is in the apices or trachea, there may be air on both sides. Differentiation must, of course, be made from gas due to a gas-forming organism, but as a rule this is not difficult. The air can be readily demonstrated on physical examination by the characteristic tissue-paper crepitation, but the roentgenogram adds information as to its amount and extent.

Pneumothorax may be present with or without fracture of the ribs (Fig. 1). In stab wounds the ribs are ordinarily not involved, and often the only roentgenographic evidence of trauma may be a pneumothorax. In wounds due to projectiles there may frequently be severe associated damage to the osseous thorax. Cases have been reported of partial or complete pneumothorax without an external wound, due to the proximity of a bomb blast, with rupture of the lung surface. I have seen one case of a bilateral pneumothorax in a man who jumped into the river in a suicidal attempt. A small amount of air was seen in either pleural cavity. Possibly a change of mind, with a desperate inhalation in an effort to avoid drowning, was responsible for the perforations.

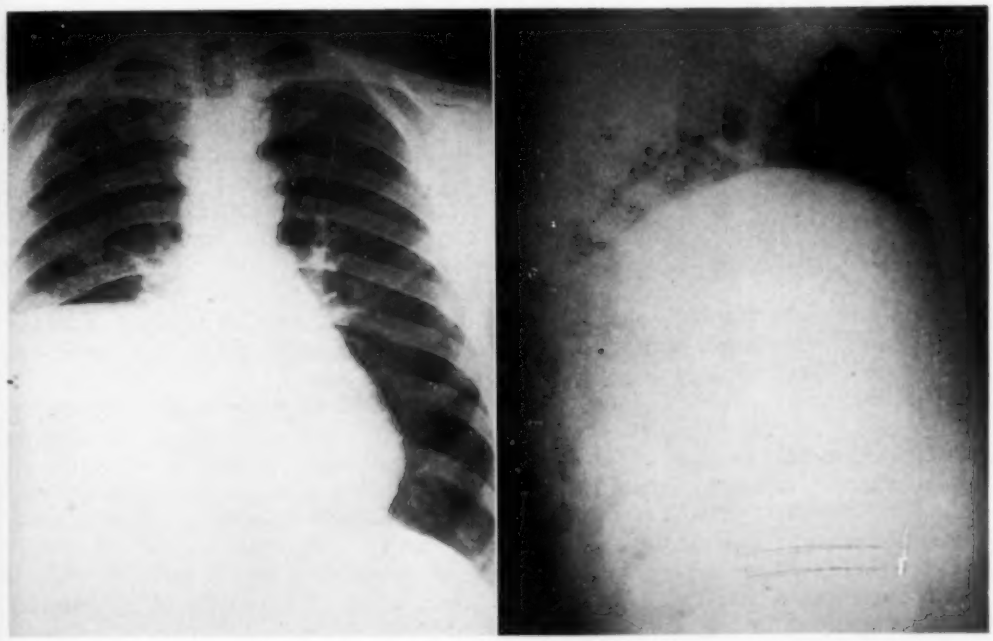
A pneumothorax may be so slight as to be barely perceptible, and films in both inspiration and expiration may be required to demonstrate it. On the other hand, it may be so extreme as to cause complete collapse of an entire lung, with displacement of the mediastinum and occasionally herniation. In some cases the increased pressure of the air in the pleural cavity may be such as to result in severe cardiac embarrassment and ultimate failure. It should be borne in mind that air in the pleural cavity does not necessarily imply perforation of the lung; it may in some cases enter through a wound from the outside, being drawn in with every expiratory movement. The reverse, of course, is true when communication exists between the lung parenchyma and the pleural cavity.

Hartung and Grossman report a case of trauma to the anterior chest wall resulting in a chest wall hernia. During quiet respiration no abnormality was observed roentgenographically. During the Valsalva act, however, a localized area of translucency was seen above the right side of the diaphragm in the seventh intercostal space anteriorly near the lateral portion of the chest wall. In the oblique position this could be seen to protrude beyond the confines of the remainder of the lung.

Hemorrhage into the pleural cavity is a frequent sequel of trauma. Roentgenographically, blood in the pleural cavity cannot be differentiated from other fluid. Frequently air is also present, producing the characteristic fluid level. Infection may set in and there may ultimately be a mixture of blood and pus. An occasional late sequel to pleural hemorrhage may be calcification in the visceral pleura. At times the trauma may cause no hemorrhage, but infection may occur with resultant empyema. Adhesions may form and this may be encapsulated. Sometimes in the postero-anterior view en-



Figs. 2 and 3. Encapsulated fluid in the lower portion of the left side of the chest. The appearance in the postero-anterior view simulates pneumonic consolidation. The lateral view shows the sharply defined area of encapsulated fluid posteriorly.



Figs. 4 and 5. Case of W. W. Stab wound in right side of chest six weeks previously; general malaise since, with recent pain at site of old wound. The postero-anterior view gives the impression of a subdiaphragmatic lesion. The lateral view also suggests a subphrenic lesion or possibly a huge interlobar accumulation of fluid. The surgeon later made a partial resection of the eleventh rib posteriorly establishing drainage, considering that he was in the pleural cavity. A film made after recovery revealed very slight evidence of pleural thickening.

capsulated fluid may simulate pneumonic consolidation, while it will be clearly outlined in the lateral view (Figs. 2 and 3).

At times interlobar or encapsulated fluid may simulate a subphrenic accumulation of fluid.

W. W., white male, age 61 years, had been stabbed in the right side six weeks before. For the past six days especially he had experienced pain in this side, with soreness in the anterior part of the chest along the costal margin and swelling about the old wound area. Physical findings suggested fluid in the right side of the chest. The postero-anterior film (Fig. 4) revealed a homogeneous opacity in the lower portion extending up to the projection field of the fourth anterior interspace, there being a slightly convex superior periphery. A subdiaphragmatic abscess was suggested by this view. The lateral view (Fig. 5) also revealed a convex superior periphery, which was compatible with such a lesion, but the visibility of the lower dorsal vertebral bodies tended to point against it. There was some suggestion that the shadow was fusiform, and a huge interlobar accumulation of fluid was considered as an alternative. Thick pus began to drain spontaneously through an area in the lower portion of the thorax posteriorly. Near this site a partial resection of the eleventh rib posteriorly was done and drainage established. The surgeon considered that the drain was in the pleural cavity. If such was the case, it is conceivable that the fluid may have been interlobar or encapsulated between the lower lobe and diaphragm. The possibility that it was subdiaphragmatic must still be considered, and the relative absence of pleural thickening on a subsequent film after recovery suggested this. A pneumoperitoneum would have been of value in this case to differentiate a supradiaphragmatic lesion from a subphrenic abscess.

Hemorrhage into the lung parenchyma occasionally occurs and may have the appearance of pneumonia, tuberculosis, or other infectious process. Occasionally atelectasis may result from consequent occlusion of bronchi or bronchioles. The mottled appearance of intrapulmonary blood will, as a rule, differentiate it from pleural fluid. Post-traumatic pneumonia can usually be readily ruled out if the film is taken immediately after the trauma. An opacity appearing in the pulmonary area after the lapse of a few days would be more apt to be pneumonia. Expectoration of bright red blood may aid in the differentiation, as well as the physical and clinical findings. The disappearance of the findings after a few days aids in ruling out a chronic infection.

In some reported cases of blast injury without apparent external trauma pulmonary hemorrhage has been present, and in some cases hemorrhage between the parietal pleura and the chest wall. In other cases, pneumothorax, atelectatic areas, or consolidation was observed, with the characteristic roentgen findings. Bronchopneumonia was a frequent sequel.

Prowse reported a case in which an aeroplane made a nose-dive into the ground, pinning the pilot upside down, with a resultant depressed fracture of the manubrium and compression fracture of the fourth dorsal vertebra. The film revealed a homogeneous opacity in both upper lobes with high translucency of the lower zones. This was interpreted as due to acute pulmonary hyperemia and edema of the upper lobes with emphysema of the lower.

A number of cases have been reported by Jones and Vinson, and others, of rupture of a main bronchus due to external injury, often with a compression of the thorax. This condition is usually so rapidly fatal that films can seldom be taken. A few cases of recovery have been reported, however, with films taken after a long interval. The roentgenogram reveals an opacity throughout the entire side of the involved bronchus with displacement of the heart and trachea to the side of the opacity, the findings being due to a massive atelectasis.

The mediastinal structures may be involved by trauma. Severe damage to the large vessels ordinarily results in almost immediate death. Occasionally, however, a patient with hemorrhage into the mediastinum may survive, in which case it is widened, showing straight vertical borders. In the presence of a dissecting aneurysm, the widening is more localized.

A blow over the precordium or a penetrating wound may give rise to hemorrhage into the pericardium, with the usual findings of pericardial fluid. If bleeding con-

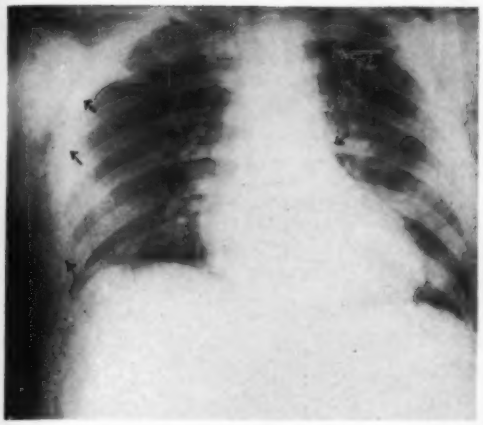


Fig. 6. Case of M. A. Trauma of unknown etiology. The film reveals fractured ribs, extensive subcutaneous emphysema, and a small amount of air in the left side of the mediastinum.

tinues, there may be a tamponading of the heart with resultant cessation of the beat. Fluoroscopy is necessary for study of such cases, the findings being those of pericardial fluid with a rapidly enlarging pericardial shadow, with decreasing impulses if bleeding continues. Repeated observations may aid.

Air is occasionally found in the pericardial sac and is demonstrated on the film by a slight clear area of separation between the pericardium and cardiac outline. A stab wound causing communication between the pericardial sac and the lung may cause air to be drawn in from the lung during the combination of cardiac systole and the inspiratory phase, or it may be drawn in directly from without.

M. A., white male, age 32 years, entered the hospital in coma, with numerous lacerations. His breath had an alcoholic odor and he was unable to give a history when consciousness returned. X-ray examination revealed a fracture of the 2d to the 6th right ribs, inclusive, in the axillary region, with extensive subcutaneous emphysema and evidence of a small amount of air in the left side of the mediastinum (Fig. 6). There was also a fracture of the pelvic bones. The chief thoracic complaint was pain in the right side of the chest, which persisted for over a month. Recovery ensued after prolonged hospitalization.

A white male, J. J., age 42 years, entered the hospital with a stab wound in the chest. He was pallid, cold, and clammy. The hemoglobin was 50 per cent, and the red cell count 3,580,000. A stab wound, four inches in length, was present in the left sternal line at about the level of the fourth to the sixth ribs. The tones were distant. Fluoroscopy and roentgenograms (Figs. 7 and 8) revealed air and fluid in the pericardial sac with no visible cardiac pulsation. Dr. Wm. Hendricks operated

Figs. 7 and 8. Case of J. J. History of stab wound with air in the pericardial sac. In the lower film, taken with the patient supine, using bilateral penetration, a fluid level was demonstrable in the pericardial sac. At operation a stab wound was found in the left ventricle.

and found a stab wound in the left ventricle 18–23 mm. in length. This was repaired. The patient recovered.

L. G., white female, age 18 years, entered the hospital, having been stabbed in the chest by her husband. She was in profound shock. The blood

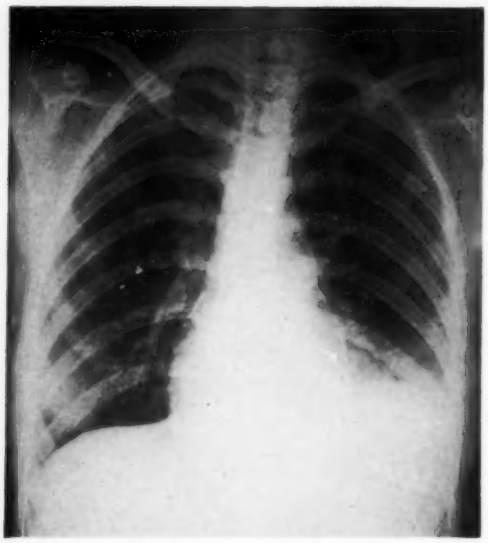


Fig. 9. Case of L. G. History of stab wound in the chest. Air is shown in the pericardial sac and a trace in the left pleural cavity. The elevation of the left dome of the diaphragm is presumably due to a subphrenic hematoma.

pressure was 80/60; hemoglobin was 57 per cent; red cell count 3,080,000. There was mild dyspnea. A penetrating wound at the level of the seventh intercostal space to the left of the xyphoid was demonstrated. Fluoroscopic and film study (Fig. 9) revealed a small amount of air and fluid in the pericardial sac with a 10 per cent pneumothorax on the left side. A fluid level was noted posteriorly. The left dome of the diaphragm was elevated and limited in motility, presumably due to a subphrenic hematoma. The chest findings diminished rapidly.

C. M., colored male, age 54 years, entered the hospital, a stab wound of the chest having occurred two hours previously. He noticed a sucking sound every time he breathed. Some pain was present. Examination revealed a gaping stab wound in the anterior chest wall. X-ray examination showed a small amount of air in the pericardial sac. There was a small area of homogeneous opacity in the base of the left side of the chest, possibly due to pleural fluid. Above this was some mottled opacity, which may have been due to a small amount of pulmonary hemorrhage, although this was not confirmed by hemoptysis. Six hundred cubic centimeters of blood were aspirated from the pleural cavity by Dr. Jerome Head, and the patient made an uneventful recovery.

Foreign bodies in the heart muscle or chambers are occasionally seen. Recently one was observed fluoroscopically in our department. A bullet in the projection field of the cardiac shadow moved with the cardiac impulses, presumably being lodged in the heart muscle. This was an incidental finding, the trauma having occurred years previously. Ordinarily such a metallic foreign body, unless very minute, can be readily detected on the routine chest film, but sometimes it may be almost obscured, in which case a higher penetration will reveal it. Foreign bodies containing elements of a low atomic weight may not be so readily demonstrable. An illustration of this is given in the following case (previously reported by B. Neiman and J. F. Fitzgerald: Am. J. Surg. **42:** 401–405, November 1938.)

E. S., white female, age 27 years, jumped eight feet through a window during a fire, striking the forehead and chest, with resulting lacerations. These were sutured. Nine months later the patient entered the hospital, having had ill health since the accident. She complained of vague pains in the right shoulder, with weakness, tendency to fainting, and pressure sensation over the heart.

The examination revealed râles in the chest with pericardial fluid. A volume of 30 c.c. of serosanguineous fluid was removed. The patient was pregnant and cardiac decompensation set in. Roentgen examination revealed increase of the cardiac borders compatible with pericardial effusion. The patient was delivered of a five-months fetus, stillborn, and died sixteen months after the accident.

Autopsy by Dr. Benjamin Neiman revealed within the heart a piece of glass 70 × 17–25 mm., and 2 mm. thick, having six sharp corners (Fig. 10). This was in the ostium of the tricuspid valve, extending into the right auricle and ventricle. There was an irregular scarring of the myocardium of the right ventricle. Old and recent mural thrombi were present in the right auricle and ventricle. There were multiple traumatic tears of the cusps of the tricuspid valve and pulmonary leaflets. A fibrous obliteration of the pericardial sac was also present, with a bilateral hydrothorax.

Here was a case where a large foreign body did not show on the film. That it could have been demonstrated if higher penetration had been used was shown by the fact that it was seen on the roentgenogram of the extirpated heart (Fig. 11).

Localization of a foreign body in the

Figs. 10 and 11. Case of E. S. Laceration of chest sixteen months previously. The drawing shows a piece of glass in the ostium of the tricuspid valve, extending into the right auricle and ventricle. The roentgenogram, made after autopsy, shows the glass within the heart, though it was not demonstrated on a film made during life probably because of inadequate penetration.

thoracic cage may be needed: first, to determine whether its location demands removal; second, to direct the surgeon in the incision if removal is required; third, to outline the path traversed by the missile. The entrance wound may be in the abdomen or in another portion of the body, with the bullet lodging in the thorax. The absence of the projectile may also be of great importance, especially if there is an entrance wound in the thorax and no wound of exit. In such a case,

Fig. 12. History of automobile accident sixteen years previously, with severe trauma to the left side of the thorax. The film shows evidence of the old left rib fractures, with intestinal loops containing air in the projection field of the lower portion of the left side of the chest. The heart is displaced to the right. Differentiation must be made between an anterior herniation through the diaphragm and an eventration. A lateral view would be of aid, as would possibly pneumoperitoneum.

the abdomen and other tissues may be considered as possible resting sites. Subphrenic air may be found if a hollow viscus has been perforated. A partially spent bullet may occasionally be guided by a rib or other osseous structure in its course.

M. M., white male, age 14 years, was shot in the left axillary border three hours previously. His general condition was good. The bullet was palpable under the skin in the left side of the thorax posteriorly at the level of the 6th rib. The film revealed the bullet at this site and numerous minute metallic fragments adjacent thereto. A fracture of the fourth and fifth ribs posteriorly was observed, and a clouding of the mid portion of the left side of the chest. No pneumothorax was demonstrated and hence the bullet probably did not traverse the lung. The clouding may be explained on the basis of hemorrhage into the soft tissues of the chest wall. The course, with no occurrence of hemoptysis, also appeared to confirm absence of pulmonary involvement.

Penetration of the diaphragm may result in subdiaphragmatic hematoma and subsequent abscess. The characteristic findings of subphrenic fluid with raised and immobile diaphragmatic dome are present.

Occasionally, however, as previously mentioned, encapsulated fluid above the diaphragm may confuse. In the posterior-anterior view, a lobar pneumonia may rarely simulate. Everett and Wood reported a case where a bomb fragment entered the chest and penetrated the liver, tearing the bile passages, with a resultant subdiaphragmatic extravasation of bile.

Trauma to the diaphragm may result in herniation. If the hernia is on the left side, the characteristic appearance of the loops of bowel in the chest will often be distinctive, but at times the picture may resemble cystic degeneration or multiple abscesses. A barium meal will serve for differentiation. At times the hernia may be confused with eventration of the diaphragm. The localization of the bulge in the lateral view will often aid. A left-sided eventration displaces the heart to the right, while a posterior hernia will not. If the hernia is located anteriorly, however, such a displacement will occur (Fig. 12). Pneumoperitoneum may at times be of value for differentiation.

Cook County Hospital
Chicago, Ill.

Back Injuries: Introduction[1]

HARRY E. MOCK, M.D., Chairman
Chicago, Ill.

LOW BACK PAIN is with us always. It was just as prevalent thirty-five years ago as it is today, and if this writer's experience went back one hundred years he probably would have found it just as prevalent then, although the busy pioneer had little time to think of his back. There is no field in medicine or surgery where changing styles in treatment have been so numerous as in this condition of low back pain.

With the advent of more powerful and faster transportation, stupendous lawsuits became the vogue and "railway spine" was the most frequent diagnosis assigned to low back pain. With the coming of the industrial age, especially when employees' compensation laws became an economic factor, our diagnostic nomenclature for low back pain increased amazingly, ranging from the old "sacroiliac sprain" to the present "herniated disk."

New and ever newer methods of treatment, often complicated and often surgical in approach, have been evolved to meet these changing styles in diagnosis. In many instances worthwhile advances in surgery have resulted, with great relief to certain persons with definite organic lesions. But to weed out those who need these more complicated or radical surgical procedures is the greatest problem confronting surgeons today. We must not lose sight of the fact that the same types of low back pain were prevalent among our fathers, grandfathers, and great-grandfathers, who, in spite of this and deprived of the benefits of modern surgery, survived and built a great country at the expense of more and longer hard, back-splitting labor than our present generation ever dreamed of performing. One great surgeon has written: "Ruptured intervertebral disks . . . are, in fact, among the most frequent lesions treated surgically." We doubt this statement, and yet it shows the great tendency to surgical attack on low back pain. We should pause and ask ourselves the question: "Has our surgical enthusiasm made the human race more back-conscious than it was in the earlier generations?"

I repeat what I have written before: when indicated by such definite neurological findings that the diagnosis cannot be mistaken, the removal of cord tumors, osteomas, or protruding disks is a gift from God. But to approach all low back pains with operation uppermost in mind is to overlook the psychogenic, the postural, the muscle imbalance, and the numerous constitutional causes that are the predominant factors in the average run of painful low back cases. For these, operations on the spine or cord are never indicated. Even if a ruptured protruding disk is found and removed—a disk which, from the history in many cases, must have protruded for years—this does not always rule out the existence of the above conditions and does not necessarily mean that the patient henceforth will be free of low back pain.

There was a time when the removal of all foci of infection seemed to offer the hope of eradicating low back pain from suffering humanity. There is many a toothless person today who still has his low back pain. There were a few where the sacrifice of the teeth gave permanent relief. The removal of one or more halves or complete laminae of the lower vertebrae is a more difficult and more dangerous procedure than the pulling of teeth. The implication is evident. It must be reiterated that this is not a condemnation of laminectomy and the removal of a ruptured intervetebral disk when and if it is

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definitely indicated. On the other hand, to consider it, or ever to make it, the commonest of all surgical procedures is to place one of the greatest advances in surgery in the toothless category.

Presented with a patient suffering from low back pain, the responsibility of the surgeon becomes exceedingly great. When there has been a severe trauma with direct injury to the back, and when the roentgenological examination shows a definite compression fracture or a dislocated vertebra, his diagnostic problem is easily solved and logical treatment can follow. But when the patient states that a sudden twist, a jerk, or the lifting of a heavy object caused the pain, and when the surgeon accepts this etiological factor and begins to treat the case without a thorough complete examination, he is shirking responsibility. Too often the mild alleged etiological factor is only an incident, while the true cause may be hidden in some constitutional or pathological condition far removed, in another part of the body. This must be sought and found when the patient first presents himself if the true diagnosis and the proper management of the case are to be logically established.

The x-ray examination of the patient's back is always indicated, but too frequently we depend solely upon the roentgenologist for our diagnosis. If the least anomaly is present in the back, too many of us jump to the conclusion that this explains the low back pain, and if there is an alleged injury we accept it as the cause for the anomaly or more often assume that the injury has aggravated an existing condition. If the x-ray is absolutely negative, then the conclusion is too readily made that "torn muscles" or "sacroiliac sprain" or some other anatomical disturbance is the cause of the pain, latterly a herniated disk. Such diagnoses confirm the idea of injury and, if the patient is employed, he immediately becomes a "compensation case."

The roentgenologist, presented with such a case and told by the surgeon that the patient has an injured back, often fixes the idea of localized trouble by describing in great detail or by merely mentioning such conditions as "slight thickening of the sacroiliac joint," "osteo-arthritis," "impinging transverse process of the fifth lumbar," "nuclear changes," "spondylolisthesis," "acute lumbosacral angle," or similar changes. As surgeons, have we made the roentgenologist feel responsible for finding some explanation for our theory that the trouble is localized in the spine? As surgeons, are we too ready to accept the roentgenologist's description of some of these spinal anomalies as the explanation of the trouble?

Roentgenologists might well ask the question: "Have you searched the entire body for a logical explanation of the low back pain before turning to the x-ray for a diagnosis?"

There are so many anatomical and constitutional causes for low back pain that the surgeon who accepts the patient's statement of alleged trauma, or who centers his examination on the low back only, or who depends solely upon the x-ray for his diagnosis, or who, without complete examination, starts physical therapy treatments (usually short-wave), or "shots," or back manipulations, or a back brace, cast, or sacroiliac belt, or turns to operative treatment, is bound to find himself in error in a certain number of these cases.

Every specialty in medicine has its share of low back pain. To jump to the conclusion that some pelvic condition, as a displaced uterus, or some genitourinary condition, usually a floating kidney, or some orthopedic condition, too often a sacroiliac sprain or a spondylolisthesis, or some neurosurgical condition, frequently a herniated disk, is responsible, or that the condition is purely one for physical therapy, likewise may lead to error.

I reiterate, there is no other field in medicine or surgery that has been the seat of so many changing styles, both in diagnosis and treatment, as has this condition of low back pain. There are so many constitutional and anatomical causes, so many psychogenic factors, that can be respons-

ible for low back pain that it is almost impossible to give one definite diagnostic name to the existing condition. Patients like the doctor who can give a definite straight-from-the-shoulder diagnosis. Thus, the osteopath, with his emphatic diagnosis of a displaced vertebra, meets their approbation. But in low back pain the conscientious doctor must delve into the psychogenic factors that may be back of it: the fatigue reactions from monotony of employment or from the high-tension under which executives or social celebrities work—the type that often suffers from spastic bowel; flat back and other anatomical poor-postural reactions, all of which are accompanied by muscle imbalance, which alone can give the severest of low back pain; and finally, he must find and explain certain constitutional conditions which may aggravate the pain. Confronted with one or all of these conditions, it is impossible to give the patient a single diagnostic entity to hang his hat on or win his confidence.

In lieu of a diagnostic entity, the patient likes the doctor who can offer a single straightforward therapeutic measure to be followed. Thus, "you need a sacroiliac belt," or "a back brace," or "a cast," or "an operation," wins the patient's confidence and, once this is won, he will continue the treatment indefinitely to prove that it was just what his back needed. It takes a great deal of time and great salesmanship on the part of the surgeon to explain the intricate factors behind low back pain, to substitute reason and common sense for a diagnostic entity, and to persuade the patient to change his habits of living, to squat and lift correctly, to go through exercises that will correct his postural defects and restore a normal muscle balance in his back, and finally to show him, as is so often the case, that the trouble lies within himself and not in an alleged injury. If the surgeon will look at the patient as a whole and not concentrate too much on the low back, he will rehabilitate a great many of these patients without too complicated or too prolonged treatment.

In these days of needed man power, this is the essence of treatment. In the major back injuries we have solved the problem exceedingly well. In the rehabilitation of the great group of sufferers from low back pain we have lagged behind.

122 S. Michigan Ave.
Chicago, Ill.

Anatomical and Physiological Considerations Prerequisite to Diagnosis of Back Trauma[1]

EBEN J. CAREY, M.D.

Marquette University School of Medicine, Milwaukee, Wis.

THE ANATOMY OF low back pain following injury involves practically the structure of the entire living human body. For the purposes of this paper, the anatomy and physiology of the back will be considered from a broad and not a detailed descriptive point of view.

The variable character of low back pain, its multiplicity of causes, the complexity of the anatomic structures involved, and the difficulties in its treatment render this affection one of the most baffling problems that confront the physician. The condition has important industrial and economic aspects. Many persons habitually assume, at work or otherwise, positions seriously at fault mechanically, and sooner or later under the stress and strain the body tissues rebel and backache results, with or without trauma. Industry suffers a severe drain on its man power from this type of affection, since slight traumata may throw on the disabled list for very long periods those whose bodies have been repeatedly insulted by postural errors and the consequent mechanical strain. Exact anatomical knowledge is necessary for accurate diagnosis.

In the past, the anatomy of the back has been neglected too frequently by medical students. Since charlatans are most liable to promise relief in fields where medical and anatomic knowledge is deficient, it becomes an obligation on each practitioner to possess knowledge of the anatomy underlying backache following injury.

ANATOMY OF THE HUMAN SPINE

The human spinal column is the central axis of the skeleton and is situated in the median line at the posterior aspect of the trunk. It is normally composed of thirty-three segments or vertebrae, twenty-four of which are true or movable and nine false or fixed vertebrae. Of the true vertebrae, the first seven are called cervical, the succeeding twelve, thoracic or dorsal; the remaining five, lumbar. Of the false vertebrae, the first five form one mass, called the sacrum, and at the terminal part of the column are three to five fused segments forming the coccyx.

The vertebral column functions as a pillar of support for the trunk and a case for protection of the spinal cord, nerve roots, and meninges. Cephalad it supports the skull; laterally, it gives attachments to the ribs, through which in part it receives the weight of the upper limbs; caudad it is supported by the hip bones, by which the weight of the trunk is transmitted to the lower limbs. The structure of the whole column accords with the necessities of these functions, and thus the vertebrae of which it is composed show their individual agreement with the general arrangement of the whole: they are modified in details according to their position, but they are all built on the same general principle.

This principle may be demonstrated, briefly, by a vertebra taken from the center of the column and used as an illustration of the positions of the chief parts of a "typical" vertebra. In front a strong body carries and transmits weight. It is the more fixed part of the column and to its dorsal aspect is attached the spinal cord. The attachment of the spinal cord to the most stable bodies prevents its overstretching in flexion of the column. The neural arch behind the bodies encloses the spinal cord: in conformity with this we find the strong pads of intervertebral disks placed be-

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tween the bodies of contiguous vertebrae, whereas the arches are connected by ligaments and tend to overlap one another. The arch is relatively more movable than the bodies. In the articulated column the successive arches and ligaments, with the dorsal aspect of the bodies, enclose a spinal canal for the cord and meninges (pachymeninges and leptomeninges), and the portion of the canal that is enclosed in the neural arch of each separate segment is the spinal foramen of that vertebra. The neural arch has spinous, articular, transverse processes, as well as laminae and pedicles. No details as to these structures are necessary in this paper.

The length of the spinal column varies in different skeletons. The average is about 70 cm. in the male and about 2.5 cm. less in the female. It constitutes about 45 per cent of the body length. To the entire length of the column the cervical region contributes about one-sixth, the thoracic about one-third, the lumbar about one-fourth, and the sacrococcygeal portion the remaining one-sixth. About one-fourth of the length of the presacral spine is made up of the intervertebral disks. The pathology of these disks is becoming more important as one cause of low back pain.

The striking characteristic of the complete articulated column, when viewed as a whole, is the presence of "curves." There are two sets of curves: the primary or accommodation curves and the secondary or compensation curves. There are four of these in the sagittal plane or profile view, convex forward in the cervical and lumbar regions, concave forward or ventrad in the dorsal and sacral zones. The dorsal curve is primary and may be looked on as the persisting curve of the embryonic axis. The sacral curve is also primary. These two primary curves are for the accommodation of the thoracic and pelvic viscera. The thoracic curve extends from the second to the twelfth dorsal vertebra, and the sacral curve coincides with the sacrum and the coccyx.

The secondary curves of compensation are found in the cervical and lumbar regions and have their convexities directed ventrad. They are curves that compensate for the assumption of the upright posture and are developed due to changes in the intervertebral disks. The cervical curve appears in the infant with the development of ventral flexion of the head on the chest, at about the third postnatal month, and with the sitting posture at about the sixth postnatal month. The curve is never consolidated or fixed in the vertebral column. It is present in the upright but obliterated in the horizontal posture.

The lumbar curve, between the twelfth dorsal vertebra and promontory of the sacrum, appears between the ninth and twelfth postnatal month when the child begins to stand and attempts to walk. This curve becomes consolidated in adult life.

The most anterior part of the cervical convexity is the front of the body of the fourth cervical vertebra, and the curve ends below at about the second dorsal vertebra: the body of the seventh or eighth dorsal vertebra usually forms the point of greatest posterior projection in the dorsal curve, which ends below between the twelfth dorsal and first lumbar vertebrae.

The fifth curve is lateral and is a secondary, compensation curve. It is in most cases directed to the right and is found in the upper thoracic or dorsal region. Its convexity, usually to the right, is probably associated with the greater use of the right hand. It is modified by race and occupation. The common finding in the ventro-dorsal view, therefore, is a physiologic right lateral scoliosis.

The primary curves of accommodation have associated direct changes in the bodies of the dorsal and sacral regions, whereas the secondary or compensation curves have associated changes particularly in the disks. At about the third week of intra-uterine life the first primary curve appears with the snail-like coiling of the entire embryo. During this time the

vertebral column has a pronounced ventral flexion. The uncoiling of the embryo occurs between the third and sixth week of intra-uterine life. The movable or free portion of the vertebral column gradually becomes straighter and later acquires a second ventral curve. In the newborn child the true or free column forms a single gentle curve with a ventral concavity extending from the first cervical to the last lumbar vertebra, while the sacrum and coccyx are directed somewhat dorsad.

In the female the sacrum is turned dorsad to a greater extent than in the male. This causes a more prominent lumbosacral angle, but it is modified by the lumbar curve becoming more pronounced; thus in women the fourth lumbar vertebra is usually more prominent than in men. If an anomalous sixth lumbar vertebra is present, there is consequently a still greater tendency to spondylolisthesis, a forward gliding of the caudal surface of the fifth lumbar vertebra over the cephalic aspect of the first sacral vertebra.

The aortic impression consists of a variable flattening of the left side of the dorsal vertebrae from the fourth to the tenth segment.

From the ventral aspect the bodies of the vertebral column present a series of pyramids due to the successive increase and decrease in the size of the bodies. They become wider from the axis to the first dorsal vertebra, then decrease to the fourth dorsal vertebra. The apex of the first pyramid is directed upward, and that of the second is directed downward. Their bases are in opposition. The third pyramid extends from the fourth thoracic to the fifth lumbar vertebra, with its base caudad. The fourth pyramid includes the sacrum and coccyx, with the base cephalad and the apex caudad.

In the lateral view, the intervertebral foramina appear oval in shape These foramina increase in size progressively, cephalocaudad, being smallest in diameter in the cervical and largest in the lumbar region. The spinous processes of the second and seventh cervical, first thoracic, and all the lumbar vertebrae are most prominent.

From the dorsal aspect the line of the spines shows frequent irregularities without any deviation in the line of the weight-bearing bodies. On each side of the line of the spines the vertebral groove runs down the length of the column, floored by the laminae and backs of the articular and transverse processes. It is occupied by the deep and superficial layers of the post-vertebral muscles.

BONY ANOMALIES OF THE LOW BACK

Many persons with anomalies of the spine are symptom-free, but their backs are less stable and more prone to stressing strain in injury. These anomalies may be classified as follows:

1. Elongation of the transverse process of the fifth lumbar vertebra, found in 25 per cent of cases of low back pain. This process impinges on the ilium and the friction forms a painful bursa.
2. Sacralization of the fifth lumbar vertebra. One or both transverse processes of the fifth lumbar may be involved. This anomaly is found in 3.5 per cent of normal persons, and in 50 per cent of these low back pain is a common experience.
3. Defect of the neural arch (spina bifida occulta). This is found in 5 per cent of the spines examined by x-ray. The spine is weak and prone to injury.
4. Variations of spinous processes (the kissing spinous processes, which come in contact with one another, forming a bursa which is painful as a result of the constant irritation by friction).
5. Variations of the lumbosacral angle. There may be abnormal lumbar lordosis which leads to sprain because the sacrum is horizontal.
6. Variation of the articular facets.
7. Spondylolisthesis.
8. Constitutional variations. The long thin individual is likely to suffer sacroiliac sprain, while a short heavy person is likely to experience lumbosacral sprain.

PHYSIOLOGY OF THE SPINE

The curves of the vertebral column serve the following purposes: (1) they contribute to the wonderful strength of the spine, sixteen times that of a straight one, since its curves are alternating; (2) they convert the spine into an elastic structure and thus afford a springy pillar upon which the head shall rest, minimizing the danger of severe jarring of the brain; (3) they are so arranged as to favor the lodgment of organs, since the cavity of the chest is greatly enlarged thereby, and the weight of the organs is still kept within the line of the center of gravity, a fact to be considered in the arrangement of muscles, as less power is required to preserve the proper balance; (4) they are so gradual as to prevent the possibility of compression of the spinal cord, which might occur were there any abrupt angles to the canal; (5) the curves of the cervical and dorsal regions add greatly to the beauty of outline of the body, while the former facilitates the movements of the neck.

The curves of the vertebral column are due, in great measure, to the variations in thickness of the intervertebral fibrocartilages, which constitute one-quarter of the length of the movable spine, but partly also to the relative thickness of the bodies of the vertebrae of the different regions, and to the tension exerted by the ligamenta subflava, which join together the laminae of the different vertebrae.

The spinal column is capable of four types of movement, *viz.*, flexion, extension, lateral, and torsion. The first two are freest in the neck, least free in the dorsal region, and less free in the loins than in the neck. This is largely due to the fact that the spines of the dorsal vertebrae overlap each other, particularly from the fourth to the eighth, and that the articular processes of the dorsal vertebrae are nearly perpendicular, so that movement is prevented; while in the cervical region the articular processes are oblique, the intervertebral disks thick, and the spinous processes of the third, fourth, and fifth vertebrae are purposely made short and horizontal. The lumbar vertebrae have also thick intervertebral disks, which allow of movement between their spinous processes; and the articular processes are so placed as to allow of a limited movement. Flexion and extension of the spine are freest between the third and sixth cervical vertebrae, between the eleventh dorsal and second lumbar vertebrae, and again between the last lumbar vertebra and the sacrum. In cases of tetanus and in those feats of the acrobat where the body is made to rest upon the head and heels alone, this point is admirably shown. The lateral movements of the spine are very free in the neck, so as to allow of an easy carriage of the head, and in the loins so as to permit of movement of the trunk. The movement of rotation of the spine is confined almost exclusively to the lumbar region, and it is this power of movement that enables the head to be rotated beyond the ability of movement of the atlas upon the axis, through a participation of the trunk. Holden suggests an admirable way to demonstrate this point: "Sit upright, with your head and shoulders well applied to the back of the chair; the head and neck can be rotated to the extent of 70°. Lean forward, so as to let the lumbar vertebra come into play; you can then turn your head and neck 30° more."

The intervertebral disks are soft and of a pulpy consistence in the central portion but firm at the edges. They thus tend to form a ball-and-socket joint which permits of a certain amount of movement in every direction between the vertebrae which they separate. By the weight of the body they are compressed, so that in the evening the height of a person is often diminished some fraction of an inch from the measurement taken after a night's repose. A habit of leaning toward one side may cause a permanent deformity by destroying the elasticity of these cartilages. Thus, a distortion of the spine may not always indicate disease.

Upon each side of the spines of the

vertebrae may be perceived a deep groove for the strong muscles of the back. If we look at the spinal column from the front, we can perceive that the transverse processes of the atlas are very long so that the muscles which rotate the head can gain additional leverage. An enlargement of the column can be detected at the lower part of the cervical region, so as to form an expanded base for the neck, and a diminution in the width of the column can be detected in the dorsal region, in order to afford more room for the lungs. A slight lateral curvature in the dorsal region may often be perceived, which is attributed by some to the excessive use of the right arm, since the concavity is usually toward the left side. This point should be remembered as a frequent and natural deformity when diagnosing a lateral curvature as the result of disease.

Along the entire length of the spinal column on its posterior aspect the spinous processes form a prominent bony ridge, which may be felt through the skin of the back even in the fattest people, and which is occasionally prominent throughout life. It will be noticed that the spine cannot be felt in the cervical as distinctly as in the dorsal and lumbar regions, for the following reasons: (1) on account of the curve; (2) on account of the attachment of an elastic ligament (the ligamentum nuchae) which extends from the head to the last cervical vertebrae and assists the muscles in supporting the head at a right angle to the spine; (3) from the fact that the spines of the third, fourth, and fifth cervical vertebrae are shorter than the rest so as to admit of free extension of the neck; (4) on account of the muscles which tend to render the long spine of the axis less prominent than it would otherwise be. In a muscular subject, the spines of the vertebrae of the dorsal and lumbar regions, instead of being prominent as they are in the skeleton, lie in a median depression or groove, which extends the entire length of the back and is caused by the prominence of the erector spinae muscles upon either side of the spines.

The spinal canal which is enclosed by the vertebrae extends throughout the entire length of the spinal column and contains the spinal cord and the lumbar, sacral, and coccygeal nerves, after the spinal cord has terminated in the cauda equina. The vertebrae so overlap each other, posteriorly and at the sides, that it would be extremely difficult for any cutting instrument to injure the spinal cord, except between the occiput and the arch of the atlas, where animals are usually "pithed," and in the lumbar region, where a cutting instrument might possibly injure the lumbar or sacral nerves. The spinal canal is larger in the neck and the lumbar region than in the dorsal, which fact is explained on two grounds: (1) because there are two enlargements present on the spinal cord (where the large nerves of the upper and lower extremities arise), which demand increased space; (2) because the dorsal region does not admit of much motion and therefore the spinal cord requires less room to insure its safety from pressure than in the neck or lumbar region, where the movements of the spinal column are more extensive.

The vertebrae are so interlocked, by their spinous and articular processes, as to render the danger of dislocation of any bone extremely slight; in fact, such an accident would be impossible in the dorsal and lumbar regions without a fracture of the processes having first occurred. In the cervical region, however, such cases have been reported, and specimens of the dislocation are shown in some of the large collections of osteological curiosities. Sudden and forcible rotation of the neck may be followed by such dislocation.

The excessive length of the transverse processes of the atlas affords one of the many examples of the provision to increase the leverage of muscles and thus to add to their power, inasmuch as the inferior oblique muscles of the neck are enabled to rotate the head with greater ease than if the transverse processes were of the same length as those of the other cervical vertebrae.

The transverse ligament, which serves to retain the odontoid process of the axis in close relation to the atlas, is an important structure, since it protects the medulla oblongata from the pressure which would otherwise be exerted upon it by that process of bone when the head is bent forward; hence, the fatal consequence of rupture of that ligament when hanging is scientifically performed as a capital punishment. In spite of the strength of this ligament and the deep groove in the odontoid process in which it fits, it occasionally slips out of its place, with fatal results. Such displacement is more likely to occur in the child than in the adult, since in a child the ligaments are weak and likely to be more relaxed. The odontoid process of the axis is much shorter in the child than in the adult and thus more readily allows the transverse ligament to slip over its apex.

The body, being the weight-bearing part of the vertebra, is built to sustain its load. Elasticity is attained in the bodies of the vertebral column by their cancellous composition. The strongest lamellae are arranged cephalocaudad in the direction of pressure from above downward. These stronger vertical bars of cancellous bone are bound together by weaker horizontal lamellae. The vertical fibers of bone are curved, with their concavities directed toward the center of the bone; the horizontal ones are slightly curved parallel with the upper and lower surfaces, and have their convexities toward the center of the bone. The vertical set is more defined than the horizontal set. The cancellous tissue of the body is covered with a thin layer of compact bone.

The number of vertebrae permits a considerable amount of movement in the complete column without calling for more than a very small amount between the individual segments, thus avoiding the weakening that would result if the segments were fewer and longer. The mechanical stability of the column under all normal movements is assured by having the axis of rotation pass through the bodies and not through the arches, so that the bodies are not displaced from one another. To this end the disks join the bodies together, and the thicker the disk the greater the amount of movement between the bodies. Thus we find that the disks are thickest in the lumbar and cervical regions, where movement is freest, and shallow in the dorsal series, where naturally the amount of motion is much restricted. In addition to the intervertebral disks, we find the bodies attached by the anterior and posterior common ligaments. The whole series of bodies forms a flexible column with the disks ensheathed in a white fibrous covering.

It is evident that a forward bending of the column will lead to a separation between the corresponding laminae and spines, and thus we find that the laminae are connected with those above and below by interlaminar ligaments (ligamenta subflava), mostly pure elastic tissue. The separation of the transverse processes in lateral flexion of the column is met by the intertransverse muscles and considerable white fibrous tissue. Lateral flexion is more limited than ventral flexion.

We may sum up the movements between the parts of the different vertebrae as follows: the bodies, being in and around the center of motion or gravity, move least, and the various processes move more, in proportion as they are far away from the body in the plane of any specific movement. The cord, with its meninges, lies deep to the neural arch. This arch moves away from or to its neighbors in flexion or extension, and thus the cord obtains the greatest possible amount of freedom from action by having no attachments to the arches. The cord is held to the dorsal aspect of the corporeal column by the adhesion of the pachymeninges to the dorsal common ligament and by the attachment of its nerves to the pedicles and disks through their sheaths of dura mater.

561 North 15th St.
Milwaukee, Wis.

The Differential Diagnosis of Traumatic Lesions of the Spine[1]

S. A. MORTON, M.D.
Milwaukee, Wis.

MY PART IN THIS symposium is to discuss certain aspects of the roentgenology of the spine. This paper will not consider fractures or dislocations but rather conditions of the spine not due to an individual trauma, which, nevertheless, may be mistaken for the results of an injury.

Fig. 1. Non-traumatic dislocation of upper cervical vertebrae. Note the anterior displacement of the anterior arch of the atlas.

Fig. 2. Laminagraph of the case shown in Fig. 1. Note the difference in the appearance of the lateral masses of the axis.

Non-traumatic dislocation at the atlanto-axial joint is a definite entity (4). This condition occurs in young people and usually accompanies an infection in the throat and in the cervical lymph nodes. It may be present in the course of a rheumatic fever. It occurs in the absence of trauma. Because of the torticollis present, it may be difficult to get satisfactory roentgenograms. The dislocation is a rotatory one and may be hard to demonstrate by the usual open-mouth position for this region. Laminagraphs are often of considerable help. Englander (11) recommends the basal view of the skull in order to show the relation between the atlas and axis. In most of these cases there is a definite separation between the posterior surface of the anterior arch of the atlas and the anterior surface of the odontoid process. Normally, in the roentgenogram these structures appear in contact (Figs. 1 and 2).

Persons who have had injuries about the neck may complain of pain in that

[1] From the Departments of Radiology of Columbia Hospital and Marquette University. Presented, as part of the Symposium on Injuries of the Head, Chest, and Back, before the Radiological Society of North America at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

area and also down one or both arms, which they are prone to ascribe to the accident. Hypertrophic changes are common about the anterior aspects of the fifth and sixth vertebral bodies, but in patients with post-traumatic neck pain, the posterior aspect of the vertebra should be examined for posteriorly projecting spurs. Oblique views of the cervical spine should always be taken in these cases if there is seen in the anteroposterior plate any considerable thickening and sclerosis of the upper corners of a cervical vertebral body (5). Sometimes these phenomena are pronounced and will explain many of the patient's symptoms, so that if they can be demonstrated soon after an accident, they must have been there before the accident and the most that can be claimed is an aggravation of a previously existing condition (Fig. 3).

In the dorsal area there are two conditions that call for consideration in the differential diagnosis between traumatic and non-traumatic conditions of the spine. One is the collapse of a vertebral body due to osteoporosis, the so-called senile kyphosis; the other is the result of disturbances in the epiphyses of a vertebral body.

Collapse of a vertebral body in osteoporosis may present some exceedingly difficult roentgenologic problems. We know that collapse can occur without the patient being aware of any specific trauma. Yet, in a person with poor bone density in the dorsal spine, a minimal injury, which would not affect a normal vertebra, may be sufficient to crush those of lessened strength. When confronted with a situation in which a person with an osteoporotic spine has been in an accident and shows a collapsed vertebral body roentgenographically, the radiologist cannot be dogmatic regarding the cause of the collapse. Because of the location and the appearance of the collapsed vertebra and its neighbors, he may feel sure that he is dealing with a solely osteoporotic lesion, unrelated to trauma, yet he cannot deny that given trauma could have been the cause.

Fig. 3. Oblique cervical roentgenogram showing osteophytic projections into a nerve canal.

There are several disturbances in the epiphyses of the vertebral bodies, the end-results of which may be mistaken for the results of trauma. Osteochondritis of the secondary vertebral epiphyses, the so-called Scheuermann's disease, is a fairly common condition. The x-ray appearance of irregular wavy upper and lower vertebral body surfaces, with symmetrical wedging of the bodies, is characteristic and does not resemble the effects of fracture. The relation of this condition to trauma is not well understood, and its morbid anatomy has not been fully investigated, so that here, too, one cannot be dogmatic when discussing the role of trauma in a given case. It would seem, however, that the burden of proof rests on anyone who would claim that the condition is due to a given injury (6).

There is another type of epiphyseal involvement which, for the want of any better name, may be called a "localized epiphysitis." This occurs in the lower dorsal or upper lumbar region and involves the upper or lower anterior corner of the vertebral body as seen in the lateral view. One vertebra—or at the most two—is involved. The appearance may resemble

Fig. 4. Old "localized epiphysitis" of a lumbar vertebra six years after original roentgenograms.

osteochondritis elsewhere; there is an increased density, with perhaps fragmentation of the anterior portion of the epiphyseal ring, and the vertebral body of the epiphysis involved is beveled off more than usual (Fig. 4).

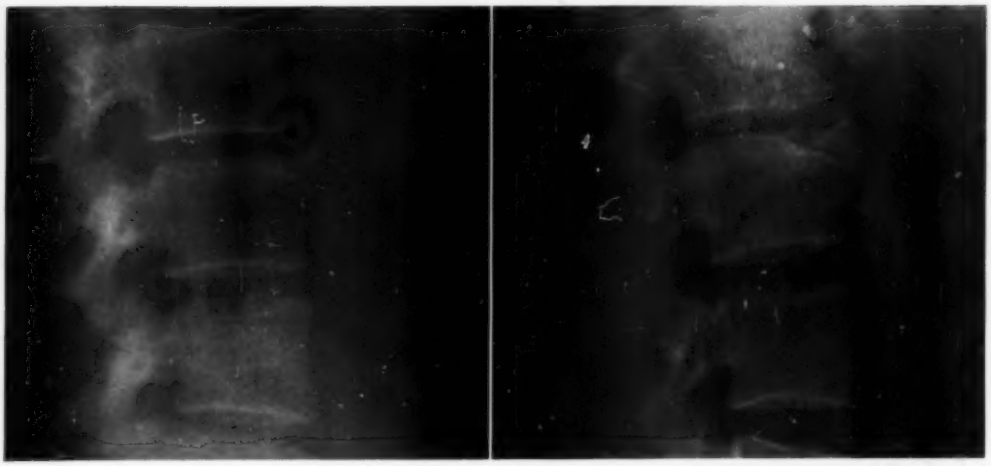
This condition which has just been discussed is of particular interest when considering the etiology of the final group of epiphyseal disorders, that is, the group showing a separation of bone at the anterior angles of the vertebral body. This condition has been discussed, particularly in the foreign literature, under the name of "persistent epiphyses." In these cases the roentgenograms reveal a defect in the upper anterior portion of the vertebral body. Above and slightly anterior to the defect is a triangular piece of bone, roughly of the same shape as the defect. At times an apparent cortex can be demonstrated about the periphery of the fragment. These findings have been interpreted in various ways. They have been called "persistent epiphyses"; they have been regarded as the result of a direct trauma (3), and, again, as a result of nuclear intrusions into the vertebral bone. That they are not true "persistent epiphyses" has been shown (1, 2), and Niedner makes a convincing case for their causation by a nuclear protrusion, like Schmorl's nodes located anteriorly in the vertebral body. This protrusion so weakens this part of the vertebral body that these corners may be pulled away by muscular or ligamentous action (2) (Figs. 5 and 6). Whatever be their origin, they should not be regarded as compression fractures. They are seen usually in men and are not necessarily associated with symptoms related to the back. They are not unusual, and the radiologist should be guarded in his statements concerning them.

The vicinity of the dorsolumbar junction is the commonest site for Schmorl's nodes. Theoretically, they should be due to trauma, but one can seldom identify an injury which could be the cause of a specific lesion.

The biconcave expansions of the intervertebral disks which one sees so often in the lumbar region should also be due to trauma, but here again it is difficult to assign any definite injury as the cause of the particular lesion demonstrated.

Kümmell's disease of the spine was a fertile topic of roentgenological argument some ten years ago. The premise that an injury to a vertebra will sometimes be followed by a latent period, after which the body will rarefy and collapse, does not seem to be established beyond doubt. It can at least be said that it is not a common phenomenon and that the radiologist had best avoid the use of the term "Kümmell's disease" unless he is very sure of his ground.

In the region of the lumbosacral junction, there is a host of congenital abnormalities with which the radiologist is familiar. These are not likely to be confused with the results of trauma, but there is one condition which has been considered to be of congenital origin that must be discussed, namely, separation at the pars interarticularis or isthmus. This phenomenon is best seen in the oblique view and may be overlooked if dependence is placed only on anteroposterior and lateral



Figures 5 and 6. So-called "persistent epiphyses": an incidental finding; no history of trauma.

projections. Separation at the isthmus is present in spondylolisthesis and is often present in the absence of any forward slipping of the body.

Is this gap of congenital or developmental origin or may it be due to a recent trauma? The defect does not look like the result of a recent localized trauma; the edges are too smooth; cortex can sometimes be demonstrated along the line of fissure; the gap is too wide, and the appearance is too uniform from one case to another. On the other hand, the gap is not in the line of any normal epiphyseal closure and it is not seen in the examination of embryonic spines, while it is present in something up to 5 per cent of adult spines, so that it is hard to explain on a congenital basis. In spite of several notable contributions (7–9), there does not seem to be any entirely adequate explanation of this phenomenon. Hitchcock (10) claims, on what appears to be good evidence, that the condition is produced by injury at birth or shortly afterward and that it is not likely to be due to trauma after the bones have developed.

A variety of names have been applied to this condition, such as pre-spondylolisthesis, spondyloschisis, and spondylolysis. These are apt to be confusing terms and it would seem best to refer to the lesion simply as an isthmus defect. It is seen usually in the arch of the fifth lumbar vertebra, but lumbar vertebrae higher up may be involved. In adult life these lesions should not be considered as due to a distinct trauma unless incontrovertable grounds for that opinion exist.

Destructive processes of the vertebral bodies due to osteomyelitis or malignant neoplasms, either primary or secondary, will not be discussed. The differentiation from the effects of trauma in these cases is usually not difficult.

The relation of hypertrophic changes about the spine to alleged trauma may be a difficult problem. One may see marked hypertrophic changes in the spines of sedentary persons with no history of trauma, while such changes may be absent or slight in others who have had much minimal trauma. Following the fracture of a vertebral body, many hypertrophic changes may develop about the damaged vertebra. In other cases, however, there are none. There seems to be little correlation between the extent of the injury and the subsequent development of hypertrophic spurs. It would seem, therefore, that one must not be dogmatic in ascribing this or that hypertrophic change to this or that injury. It may have had nothing whatever to do with it.

CONCLUSIONS

The radiologist can identify a certain group of appearances, such as the usual fractures and dislocations and say that they are definitely due to a specific trauma. There are several conditions of obscure etiology which produce manifestations in roentgenograms of the spine which might be regarded as the results of a definite injury, but which are likely not. In this group the radiologist must be excessively careful; he must not be too dogmatic and he must take an entirely objective view.

3321 N. Maryland Ave.
Milwaukee, Wis.

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Pseudotumor of Bone in Hemophilia[1]

ARTHUR P. ECHTERNACHT, M.D.

Indianapolis, Ind.

HEMOPHILIA IS A constitutional disease characterized by a delayed clotting time of the blood and a lifelong history of repeated prolonged hemorrhages. The disease is hereditary and its transmission depends upon a sex-linked recessive mendelian characteristic. Since hemophilia is dominant in the male and recessive in the female, women never suffer from the disease but transmit it to some of their male offspring.

The existence of the disease in early times is intimated, according to Quick (1), by certain passages in the *Talmud*. In *Tractat Jebamoth* is an account of four sisters who lived in Zipporah. The first three lost their sons when they were circumcised. Quick states that it is logical to assume that hemorrhage was responsible for death following this religious rite. Albucasis (2) in 1519 reported a condition resembling hemophilia. He stated that in a certain village there were men who, when wounded, suffered uncontrolled bleeding which resulted in death. Otto (3) in 1803 was the first to establish the fact that the disease was a distinct clinical entity.

Wright (4) in 1893 was the first to report specifically that the clotting time was prolonged in this disease. Alexander Schmidt (5), however, must be credited with the first attempt, in the same year, to determine experimentally the defect in coagulation which is responsible for hemophilia. Quick, Stanley-Brown, and Bancroft (6) concluded that there is a deficiency of thromboplastin in this disease. Sahli (7) in 1910 reported his studies showing that normal blood cells when added to hemophilic blood hastened coagulation. He did not determine which particular cell was responsible. In 1914 Fonio (8) proved that the important cells which function abnormally in hemophilia are the platelets. His work was confirmed by Minot and Lee (9), who stated: "In hemophilia we have an hereditary defect in the blood platelets. This defect consists of a slow availability of the platelets for the purpose of coagulation." In a subsequent review of hemophilia, Fonio (10) concluded, on the basis of his or other workers' reports, that in hemophilia the platelets are abnormally resistant and therefore deliver the platelet clotting factor too slowly for normal coagulation. Quick states that the primary defect may be the lessened tendency of platelets to agglutinate and refers, also, to the work of Lee and Erickson (11), who reported that the disintegration rate of platelets is retarded in hemophiliacs and in menstruating women. He suggests the possibility that a sex factor exists which tends to keep the platelets labile and that this factor is depressed during menstruation and chronically deficient in hemophilia.

Hemorrhage in hemophilia may be external or internal. It may be the result of trauma or spontaneous. Common sites of bleeding are the various joints, of which the most frequently involved are those most commonly subjected to trauma, namely; the knee, elbow, ankle, hip, shoulder, and those of the hands and feet. Koenig (12) in 1892 first described the pathological sequence of events occurring in hemarthritides. His work has been reviewed by Prip Buus (13) and others. Shaw (14) was probably the first to describe, in 1897, the roentgen findings in a case of hemarthrosis due to hemophilia. Since his initial report the literature, both English and foreign, has become abundant on this subject. More recent roentgenographic studies have been made by Freund (15), Doub and Davidson (16),

[1] From the Department of Radiology, Indiana University Medical Center, Indianapolis, Ind. Accepted for publication in June 1943.

Fig. 1. The appearance of the left leg a few hours prior to amputation. Note the biopsy site and area of necrotic skin.

Reinecke and Wohlwill (17), Key (18), Thomas (19), Newcomer (20), Caffey and Schlesinger (21), and McDonald and Lozner (22).

Because of the fact that little has been written regarding bone lesions beyond the epiphyses in hemophilia, and because of the unusual findings in one case, it has been considered worthy of report.

CASE REPORT

P. W. (R-4691), a 13-year-old white boy and known hemophiliac, was readmitted to the medical service of the James Whitcomb Riley Hospital for Children on Jan. 7, 1939, complaining of a painful swelling over the anterior surface of the left leg below the knee and loss of appetite and weight of three weeks' duration.

Family History: The mother, living and well, had two great uncles who were supposed hemophiliacs. The father was living and well. The patient had a brother living with complaints similar to his own and two sisters living and well.

Past History: The patient's birth and development were normal. He had scarlet fever, pertussis, chickenpox, mumps, and poliomyelitis all prior to his first admission at the age of 7 years. He had always bruised easily and, with even the slightest injuries, hemorrhages occurred beneath and in the skin, disappearing very slowly. Since the age of three he had experienced stiffness of various joints of varying degree and on numerous occasions had been obliged to remain in bed for periods of several weeks because of painful, stiff, swollen joints.

Hemophilic History: 12-6-32: At the age of 7, the patient was admitted complaining of severe abdominal pain and vomiting for 24 hours. Red blood cells 1,570,000. Platelets 210,000. Clot retraction time 3 1/2 hours. Coagulation time 6 minutes. Bleeding time 3 minutes. Diagnosis: Intramuscular hemorrhage in the abdominal wall due to hemophilia. Gradual improvement followed small blood transfusions and sensitization to sheep serum. The patient was discharged to the clinic for follow-up and periodic injections of sheep serum.

1-24-33 to 8-8-33: In this period the patient made eight return visits to the clinic for observation because of severe bleeding for a week following a cut finger and for numerous hemorrhages into the elbow, shoulder, knee, and ankle joints, the dorsum of the right hand, and the right great toe.

9-16-33: At the age of 8 the boy was readmitted because of a painful swelling of the knee and thigh. He received blood transfusions, ovarian extract, sheep serum, and physiotherapy and was discharged 12-7-33.

3-13-34: Readmission because of a cough and pronounced swelling of the soft tissues of the anterior portion of the neck from the mandible down over the chest to the level of the nipples. The skin over this area was dark blue in color. The swelling was checked following small blood transfusions and had disappeared by the time of discharge, 3-26-34.

11-6-34: Readmission, at the age of 9, because of a painful swelling of the left knee and numerous subcutaneous hemorrhages over the body, which occurred during sleep. These responded well to treatment and the patient was discharged 11-22-34.

3-26-35: Readmission because of a painful swelling of the left ankle, which occurred during sleep. Improvement following small transfusions; discharge 6-8-35.

8-27-35 to 3-24-36: During this period the patient was seen in the clinic five times because of painful swellings of the right elbow, right knee, right

great toe, and left knee. He was treated on each visit with sheep serum and whole ovarian extract.

4-21-36: Readmission, at age of 10, because of a perisistent, painful, discolored swelling and stiffness of the left knee of two months' duration. During this admission the right elbow became swollen spontaneously. Bleeding time 1 minute. Clotting incomplete in 10 minutes. Platelets 332,830. Symptomatic treatment and small transfusions. Discharge 5-11-36.

8-26-36: Readmission, at age of 11, because of a scalp laceration which had been bleeding for eighteen hours. Swelling and stiffness of both knees and right elbow of ten days' duration. Satisfactory response to blood transfusions and sheep serum.

3-7-37: Readmission because of hemorrhages into both elbows, left ankle, calf of left leg, and right thigh occurring during the preceding three weeks. Bleeding time 1 1/2 minutes. Clotting time 21 minutes. Response to treatment, with discharge 3-21-37.

5-1-37 to 7-1-38: The patient was seen in the clinic on numerous occasions for hemorrhages into both elbows, both knees, and left hand, right great toe, right cheek, and subcutaneously over the entire body. Treatment consisted of whole ovarian extract and sheep serum.

8-29-38: Readmission, at the age of 13, because of severe pain and stiffness in the left hip of twenty-four hours' duration and numbness of the left lower extremity. Treatment by traction, transfusions, and sedation. Discharged improved 9-11-38.

11-11-38: Seen in clinic because of a painful swelling on the anterior surface of the left tibia just below the knee. The knee was also swollen but not painful.

Present Illness: About three months prior to the patient's final admission, in 1939, he received a slight injury to the upper third of the left shin. Slight swelling occurred over the area but remained localized until three weeks prior to admission, when it began to increase gradually in size. During the two weeks preceding admission the swelling became firm, red, warm, and very painful. During this period the patient lost appetite and weight.

Physical Examination: Temperature 100°. Pulse 102. Respirations 18. The patient appeared pale and listless. The general physical examination was negative except for the following: (1) A firm swelling about 10 cm. in its greatest diameter over the anterior surface of the proximal third of the left tibia. The skin over this area was tense and shiny, with areas of reddish-brown discoloration; it was warm, and very tender to touch. (2) Slight swelling and stiffness of the left knee, which was held in about 30° flexion. (3) Slight swelling and limitation of motion of the right knee. (4) Swelling and slight stiffness of the left elbow. (5) Ecchymosis over the right upper arm.

Laboratory Examination: Hemoglobin 10 gm.; red cells 4,300,000; white cells 7,700; differential count normal; platelets 473,760. Clotting time 6 minutes. Bleeding time 2 minutes. Kline and Mazzini tests negative. Urinalysis normal.

X-ray Examination (1-9-39): Roentgenograms of the left knee showed destruction of the cortex and underlying cancellous bone in the anterior aspect of the proximal third of the tibia, with undermining of the tibial tuberosity; thickening and elevation of periosteum with "cuff" formation on the anterior and lateral aspects of the tibia at the level of the lower limits of the overlying soft tissue tumor; deepening of the intercondylar notch of the femur; evidence of subchondral necrosis in the condyles of the femur. Impression: (1) Old hemarthrosis; (2) sarcoma of tibia.

Clinical Course: The patient's blood was typed and cross matched with several donors and he was given a 400 c.c. citrated blood transfusion. The pain was worse at night; local heat and swelling persisted. The temperature continued irregular, varying from 100° to 102.5°. Orthopedic consultation suggested the following possible diagnoses in the order given: (1) hemangioma of bone; (2) osteomyelitis; (3) osteogenic sarcoma. Conservative treatment except for aspiration was advised. On Jan. 10, the left knee joint was aspirated with a 2 1/2-inch No. 18 needle. The needle penetrated tissue more resistant than normal for the first 2 1/4 inches; fresh blood under considerable pressure was encountered by the last 1/4 inch of the needle. A specimen of blood (20 c.c.) was sent to the laboratory, but culture was sterile and no tumor cells were found.

The patient was presented to the weekly seminar and it was generally thought that the lesion of the left tibia was probably a neoplasm rather than an infection or hemangioma of bone. Aspiration biopsy followed by x-ray therapy was recommended.

Roentgenograms of the chest and skull (Jan. 21, 1939) were negative for secondary neoplastic growth and other disease. Aspiration biopsy of the tumor yielded thick red material which clotted quickly. Microscopic study was negative for tumor tissue, revealing only blood.

From Jan. 23 to Feb. 8, inclusive, 1,600 r (measured in air) were administered in daily doses of 200 r to alternate medial and lateral 15 × 15 cm. fields over the tumor below the left knee. The physical factors used were 200 kv., Thoraeus A filter, 50 cm. T.S.D., H.V.L. 1.35 mm. Cu.

On Feb. 3 a roentgen study of the left leg (Fig. 2) revealed an extension of the tibial lesion inferiorly. The cortex was destroyed over an area 5.5 cm. in length. There was a marked periosteal reaction present at the inferior margin of the tumor. The original film revealed some faint areas of calcification in the soft-tissue tumor medial to the destroyed area in the bone. Diagnosis: Bone sarcoma.

On Feb. 6 and 7 doses of 75 r (air) were delivered

through a 15 × 15 cm. field over the spleen, with the same physical factors that were used in treating the leg. This was given in an attempt to control the continued bleeding.

In addition to the x-ray therapy small daily blood transfusions and symptomatic treatment were given. The increase in the size of the tumor was apparently arrested for a few days, although other hemorrhagic lesions appeared over the body.

The tumor again began to enlarge and central necrosis of the skin developed over the lesion. On Feb. 10 an exploratory incision by electrocautery was made through the skin and deep fascia on the antero-medial margin of the tibia and the overlying tumor. Beyond the deep fascia a mass of old blood clot was encountered. This was expressed in fragments and the entire tumor was found to be filled with hematomata of varying age. Those on the anterior margin of the leg beneath the point of impending skin necrosis showed partial organization. A specimen was sent to the laboratory for study. Digital and visual exploration of the anterior margin of the tibia, which was exposed after evacuation of the hematomata, disclosed a bony defect in the proximal end of the diaphysis adjacent to the epiphyseal line and joint capsule. No neoplastic tissue appeared to fill this defect. On the anterior surface of the tibia in its proximal third was an area of bone denuded of periosteum, but again no neoplastic tissue was seen grossly. A piece of crushed homologous muscle was used to fill the defect in the proximal end of the tibia at the growth line, the presumable site of the original hemorrhage, and the cavity previously filled by hematomata was closed by a compression bandage held in place by an Ace bandage following closure of the incision.

Fig. 2. X-ray study of the involved bone and joint. Note the deepening of the intercondylar notch of the femur, the areas of subchondral necrosis in the femur, area of bone destruction in the tibia, and the periosteal "cuff" on the lower margin of the tibial lesion. Compare the latter findings with those in Fig. 3.

Microscopic study of the specimens revealed blood and fibrinous clot, degenerated periosteum, and osteoid tissue. No neoplastic tissue was found.

The patient experienced relief of pain following the evacuation of the hematoma. No bleeding occurred until the third postoperative day, when slight hemorrhage was noted. There was no hemorrhage and the wound was dry when the dressing was removed on the fourth day. It was noted, however, that the point of impending skin necrosis anteriorly over the tibia had become definitely necrotic.

On Feb. 18, the seventh postoperative day, the patient became restless and complained of severe pain in the left knee, finally requiring morphine for relief. He then complained of pain in the right

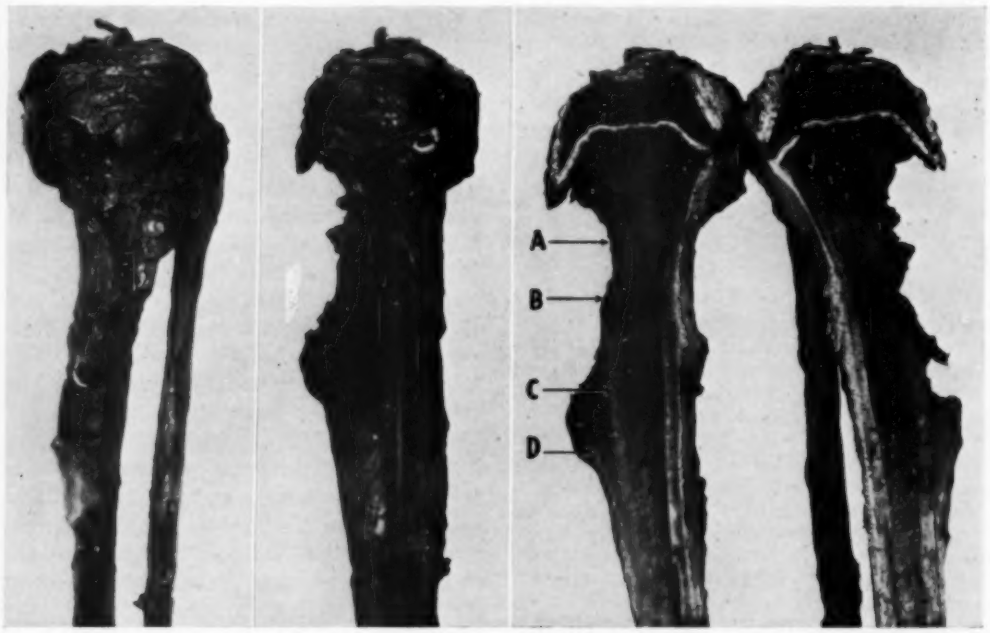

Fig. 3. Longitudinal section of the disarticulated left tibia. A. Eroded bone. B. Area of cortical necrosis and hemorrhage. C. Limits of normal cortex. D. Thickened periosteal "cuff."

upper quadrant of the abdomen and vomited. The liver was enlarged and tender. Upon removal of the surgical dressing, blood spurted across the room and bright red blood then drained continuously. A tourniquet was applied and 15 c.c. of fresh blood were injected into the evacuated area of bone. Bleeding ceased and the tourniquet was slowly released without further immediate bleeding. The following day bleeding began and could not be controlled. The hemorrhage appeared to be coming from the denuded bone. After all other measures failed, a disarticulation amputation at the knee was done. The operative note follows.

"Under nitrous oxide, oxygen and ether analgesia the skin around the left knee was washed with tincture of green soap and prepared with tincture of merthiolate. With a pneumatic bandage around the upper thigh, skin flaps were outlined with the electrosurgical knife below the knee joint, leaving as much skin as was possible without getting into the necrotic area. Upon cutting through the skin it was found that the hematoma below the anterior tibial tuberosity had extended posteriorly and superiorly into the popliteal space and the surrounding tissues were somewhat damaged by pressure necrosis. Despite this fact, it was felt that the advantage of the disarticulation leaving some necrotic tissue would outweigh the possible advantage of doing an amputation at the thigh through healthy tissue but leaving raw bone which could bleed from the medullary cavity. Accordingly a disarticulation was performed at the knee. Popliteal vessels were isolated and ligated doubly with heavy black silk and again with chromic catgut No. 1. The tourniquet was released above the knee and bleeding was found to be controlled except for slight oozing. Fascia was brought together over the end of the femur with chromic catgut No. 1, subcutaneous tissues were approximated with hemostatic sutures, and the skin closed with black silk without undue tension. A light dressing was applied and the patient was not bleeding when he left surgery in fairly good condition."

The patient was treated with sedation and small blood transfusions following amputation.

On Feb. 22, the third postoperative day, the thigh became considerably swollen and painful. Fresh bleeding occurred from the stump, the patient's general condition grew rapidly worse and death occurred.

The pathological report on the amputation specimen follows. "The disarticulated left leg shows enormous swelling in the region just below the knee. A large defect in the skin occupies the anteromedial aspect just below the knee joint. Over the tumor and beneath it, apparently composing the tumor, is a mass of deep red, jelly-like blood clot. Posterior and medial to this area is a closed recent biopsy wound. The soft tissue was removed and the bone and joint studied. The cavity occupied

by the blood clot has a multilocular appearance and is lined with relatively smooth connective tissue. The hemorrhagic area seems to stop at the epiphyseal line. The joint shows evidence of some cartilaginous destruction with replacement of some of the joint cartilage by fibrous tissues, which it is suspected represents the results of previous hemarthrosis. On longitudinal section (Fig. 3) an erosion through the anterior cortex of the tibia down deep into the cancellous portion is found. In the deepest portion hemorrhagic necrotic areas extend practically to the cortical bone on the posterior side. The epiphysis above the defect is undermined by the process of bone destruction, and the lowermost portion of the crater shows a shelf-like area of persistent, though uncovered, cortical bone and cuff-like swelling of the periosteum which shades off into the normal periosteum below.

"Micro-sections through the joint surface show replacement fibrosis of some of the joint cartilage and evidence in this fibrous tissue of old hemorrhages. The blood vessels about this area show a very pronounced endarteritis, presumably due to x-ray therapy. In fact, the blood vessels of all the sections studied show this severe endarteritis. Sections through the thickened periosteum at the margin show a superficial layer of hemorrhagic fibrino-purulent exudate which lies above the extremely thickened and hemorrhagic periosteum. Sections of the cancellous bone show the bone spicules somewhat atrophic and nowhere in the sections do we find evidence of bone regeneration either in the cancellous or in the periosteal tissue surrounding the defect in the bone. Numerous sections made from various portions of the bone show no indication of neoplasm.

"*Diagnosis:* Large subperiosteal hematoma with massive necrosis of the underlying bone and necrosis and infection of the overlying skin."

DISCUSSION

Much has been written about the roentgenographic findings in the various stages of hemophilic arthritis. In general these can be divided into three stages comparable to those of Koenig (12), based upon the pathological changes: (1) simple hemarthrosis with swelling of the joint capsule and surrounding soft tissues and clouding of the joint; (2) a panarthritis with progressive destruction of the cartilage and ends of the bones, deepening of the intercondylar notch of the femur due to the expanding hematoma, much like the erosion due to an aneurysm, punched out areas of destruction in the subchondral bone, bony lipping at the joint margins, organization and calcification within the hematoma; (3) a tendency toward healing by the production of fibrous or osseous ankylosis—arthritis deformans.

Little has been written regarding any findings in the shafts of the bones. A rather complete review of the available English and foreign literature reveals the fact that at least three cases similar to ours have been reported, two involving the femur and one the bones of the thumb.

Starker (23), in 1918, reported the first case of its kind that he could find in the literature. The patient was a 14-year-old boy, a known hemophiliac, who presented himself because of a painful tumor on the right thigh, the size of his head. This had been present for eight months. The skin over the tumor was tense and discolored. The clinical diagnosis was sarcoma of bone and hemophilia. X-ray studies revealed a soft-tissue tumor surrounding the distal half of the femur, 9×22 cm., with periosteal elevation and reaction at the superior border of the tumor 2 cm. in length, thinning of the cortex, and in places destruction of the cortex and spongiosa in the metaphysis, and bone proliferation at right angles to the shaft. The x-ray diagnosis was sarcoma of the bone. Biopsy and amputation were not done because the patient was known to be a bleeder. The tumor was probed and 750 c.c. of pure blood were aspirated, with disappearance of the tumor, leaving a flabby sac. The sac refilled in four days and the patient died ten days later. Autopsy revealed a hematoma 2.5×15 cm. over the anterior aspect and 6×22 cm. over the posterior aspect of the femur. The hematoma had a fibrous capsule. The periosteum was ossified at the superior border 1 to 4 mm. thick. There was erosion of the cortex and spongiosa beneath the hematoma at the lower end of the femur. Calcified connective-tissue strands extended from the cortex to the elevated periosteum on the anterior surface. Histologically no evidence of neoplasm was seen. The author concluded by stating that a hematoma with ossification in its

wall is hard to differentiate from neoplasm roentgenologically.

Reinecke and Wohlwill (17) reported the case of a 27-year-old male who was a known bleeder, having had numerous episodes of bleeding into various joints. The patient presented himself for treatment because of an enormous swelling of the soft tissues of the thigh, which was thought to be due to an old and recent soft-tissue hemorrhage. The knee was aspirated and liquid blood under high pressure was obtained. Three months later a high temperature suddenly developed, the patient became anemic, showed signs of generalized infection for six days, and died. Postmortem x-ray studies revealed roughening of the cortex of the femur with erosion resembling that seen in the vertebrae and sternum due to aortic aneurysm. There was also evidence of periosteal new bone formation on the lateral aspect of the femur. The pathological report was as follows: "Sagittal section of the femur reveals the middle half of the bone to be surrounded by an extensive subperiosteal hematoma measuring 10 cm. in length, 2 cm. in width on the medial aspect, and 7 mm. on the lateral aspect. There is irregular erosion of the bone beneath the hematoma, and above and below the hematoma the periosteum is thickened and shows periosteal new bone formation. Microscopic studies reveal no tumor tissue, only sequestra, granulation tissue, and some giant cells."

Firor and Woodhall (24) reported the case of a 16-year-old male who was also a known hemophiliac. Their patient had a painful swelling of the right thumb which had been previously x-rayed and diagnosed as bone sarcoma. The entire thumb was involved in a globular, symmetrical enlargement extending from the metacarpophalangeal joint laterally and medially to the web space. The skin was shiny, reddish-black in color, and perforated at one point, from which there was a slow constant effusion of thick, dark blood. X-ray examination revealed destruction of both phalanges and the metacarpal of the right thumb. The suggested diagnosis was new growth. The tumor was aspirated in an attempt to control the severe, constant pain. The lesion continued to bleed and remained swollen and painful. It was finally decided to attempt amputation. This was successfully done by electrocautery with no excessive bleeding. The postoperative diagnosis was destruction of bone by pressure from a hematoma with no evidence of tumor. The authors concluded that lesions such as that in their case, involving small articulations, may not reach the final stage of hemarthrosis due to the weaker joint structures and their resultant inability to check the expanding hematoma.

SUMMARY

Hemophilia may cause subperiosteal hemorrhages with resultant proliferation and thickening of the periosteum, erosion of the underlying cortex and cancellous bone, and organization and calcification of the hematoma, producing roentgen changes resembling bone sarcoma. Such a case is presented and three similar cases from the literature are briefly reviewed.

NOTE: The author wishes to acknowledge the invaluable assistance of Dr. Charles F. Roland, Resident in Radiology, Indiana University Medical Center, in the translation of the foreign literature.

Indiana University Medical Center
Indianapolis, Ind.

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Diffuse Calcification of the Placenta Demonstrable in Vivo[1]

SYDNEY THOMAS, M.D.
San Francisco, Calif.

CALCIFICATIONS in the placenta occur normally and should not arouse suspicion of disease in the mind of the radiologist or obstetrician. Pathologists have known for a long time that microscopic and even macroscopic areas of calcification in the mature placenta are quite normal (1). The process is a simple degenerative one and not usually associated with any fetal or maternal disease. The calcifications occur on the maternal side of the placenta in fine linear areas of degeneration of the syncytial-like structure known as the trophoblast. The amount of calcium depends on the duration of the pregnancy (2) and also on the calcium metabolism of the mother (3).

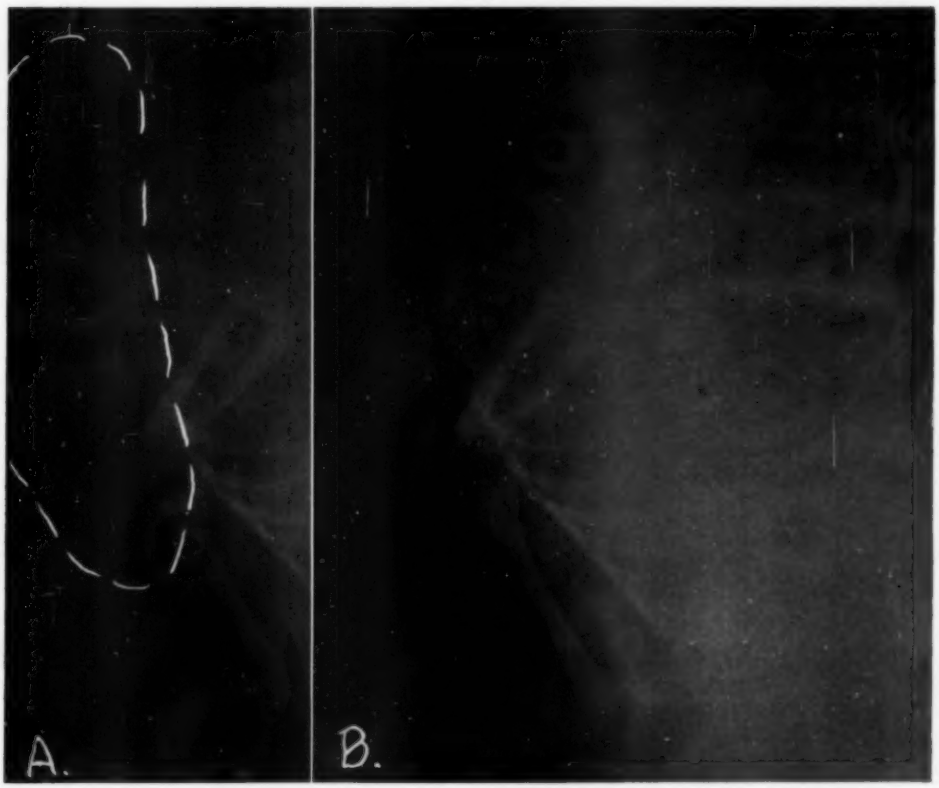

Fig. 1. The lateral radiograph of the abdomen shows the placenta outlined in ink (A) and unretouched (B). Much of the fetus is also seen. The calcifications are easily made out.

One reason why these opacities have not been reported by radiologists is the nature of the calcification rather than its absence. Because the calcifications are minute and are spread over a wide area, with a thick soft-tissue mass beneath; because the fetus frequently is moving or the uterus

[1] From the Department of Radiology, San Francisco Hospital, San Francisco Department of Public Health (J. C. Geiger, M.D., Director), and Leland Stanford University School of Medicine. Accepted for publication in June 1943.

Fig. 2. More detailed reproduction than Fig. 1, showing the reticular pattern of the placental calcifications.

contracting; because of the motion transmitted by the uterine or aortic vessels; and sometimes because the radiographic screens are worn or the focal spot of the tube is large, calcifications in the placenta are not often seen in examination of the pregnant uterus. With the advent of the rotating anode tube and general improvement in technic one must expect that they will be seen more often.

CASE HISTORY

A 19-year-old primipara in good health was first seen toward the end of the fifth month of pregnancy. The only remarkable finding at that time was poor dental hygiene. One month before her delivery date she entered the hospital complaining of painless bleeding for three days. The exact date of conception was in question due to irregular bleeding. The possibility of a placenta praevia was considered and films were made to localize the placenta. In the lateral film of the abdomen numerous opacities were seen within the placental shadow (Fig. 1). Vaginal examination revealed an ulceration on the posterior lip of the cervix. The patient gave birth to a normal female child weighing 8 pounds and 3 ounces after a sixteen-hour labor on the estimated 324th day ($10^1/_2$ months) of her pregnancy.

SUMMARY AND COMMENT

A case of diffuse calcification of the placenta is presented. The finding of calcification in the placenta has not previously

Fig. 3. Roentgenogram made two hours after delivery, showing the intact placenta with the calcifications, which are heaviest at the periphery of the cotyledons.

been described in the radiological literature. The patient was a 19-year-old primipara, gravid some ten months. The long pregnancy correlates nicely with the carefully worked out studies of Masters and Clayton, who found that the longer the pregnancy the larger are the amounts of calcium (normally) found in the placenta.

The presence of calcifications in the placenta should not lead to a diagnosis of disease. The reticular pattern of the calcification should always be looked for in suspected placenta praevia; its loca-

tion may obviate special procedures such as iodide or air cystography.

San Francisco Hospital
San Francisco, Calif.

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Pneumonic Densities Obscured by the Cardiac Shadow[1]

CAPTAIN GEORGE H. STEIN, M.C., A.U.S.
Radiologist, Station Hospital, A.A.F.T.S., Sioux Falls, S. Dak.

FROM A SURVEY of an extensive series of roentgenographically proved pneumonias, it has become manifest that areas of pneumonic density may sometimes be obscured by the cardiac shadow on the roentgenogram. Since approximately two-thirds of this shadow lies on the left side of the thoracic spine, it overlaps the mesial and lower portion of the left lung in the routine postero-anterior view. An analysis of the structures portrayed on the roentgenogram of this area reveals a superimposition of the lung itself with its bronchovascular markings, the ribs and the costovertebral articulations, and the heart shadow. In the normal subject, this area should appear as a fairly homogeneous shadow. Any variation or change in the uniformity of the density should arouse suspicion of the presence of a pneumonia in this region. Further radiological examination with left oblique or left lateral projections should make it possible to rule out or confirm such a process, which might otherwise be overlooked (Figs. 1 and 3).

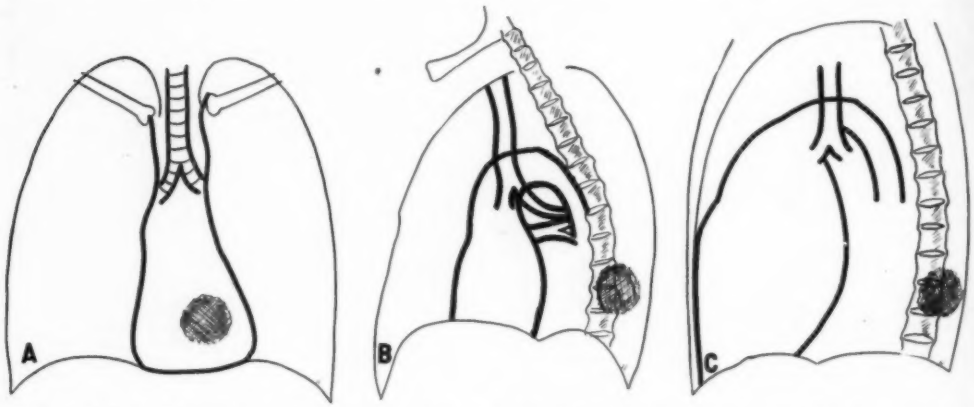

Fig. 1. Case 1: Pneumonic process overlying the bodies of the lower dorsal vertebrae. Tracings from postero-anterior, left oblique, and lateral roentgenograms. A. Postero-anterior projection: pneumonic density obscured by the cardiac shadow. B. Left oblique projection localizing pneumonic process in left lower lobe. C. Lateral view, localizing the process posteriorly in the left lower lobe.

The fact that a pneumonic process may be obvious roentgenographically in one portion of the chest does not rule out the possibility of another pneumonic lesion hidden behind the cardiac shadow in the left lung (Fig. 2).

The recognition of a pneumonia obscured by the cardiac shadow is an important factor in the differential diagnosis of intra-abdominal and intrathoracic diseases, for it may prevent needless operative exploration, as in Case 1, reported here. Meningeal irritation may be of pneumococcal origin, and here, too, a complete pulmonary examination with multiple views is necessary.

A pneumonia may be present in the left lower lung field with the mesial portion extending behind the heart. In spherical pneumonic consolidations this creates a curious *half-moon* effect. The use of an over-exposed film technic will demonstrate this satisfactorily (Fig. 4).

CASE 1: Pfc. H. D. M., aged 21, entered the Station Hospital, A.A.F.T.S., Sioux Falls, South Dakota, on April 8, 1943, with nausea and vomiting,

[1] Accepted for publication in May 1943.

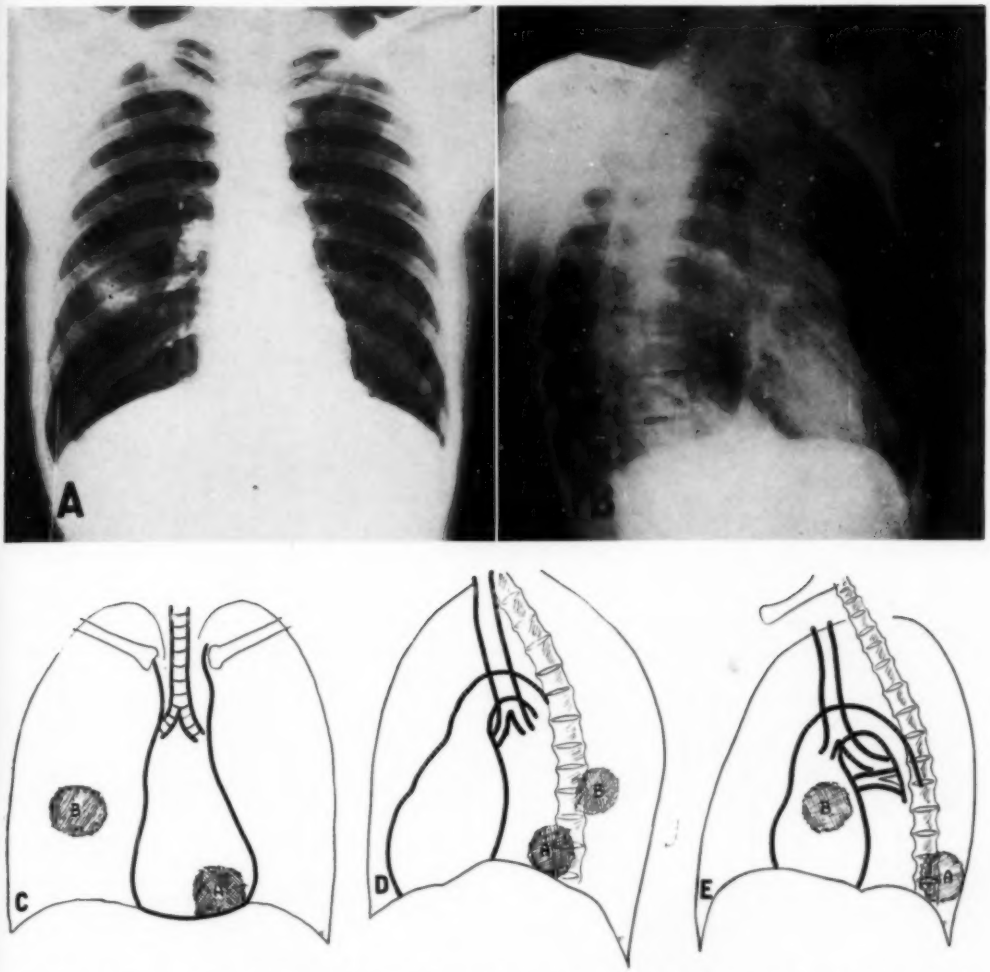

Fig. 2. Case 2: A. The spherical pneumonic density in the right lung is easily identified in the postero-anterior view, but the increased density in the left lower lobe is obscured by the heart shadow. B. In the right anterior oblique view both areas of density are separated from the cardiac shadow and are easily seen.

C, D, and E. Tracings of the postero-anterior, right anterior oblique, and left anterior oblique roentgenograms. Note how easily the pneumonic density (labeled A in the diagram) can be overlooked in the conventional postero-anterior projection (C), since the focus of attention is drawn to the more obvious lesion in the right lung (labeled B in the diagram). The right anterior oblique projection (D) readily demonstrates the presence of the two pneumonic processes. The left anterior oblique projection (E) localizes the pneumonic density previously obscured by the cardiac shadow in the region of the left lower lobe. It is interesting to note that in this oblique view the pneumonic process in the right lung is obscured by the cardiac shadow.

pain in the epigastrium, and tenderness in the right abdominal quadrant. A tentative diagnosis of appendicitis was made and the patient was admitted to the surgical service. Cough and expectoration were noted and physical examination revealed dullness and fine râles over the left base posteriorly. The temperature was 103.2°, pulse 118 and respirations 22.

X-ray examination of the chest, April 8, 1943, disclosed a pneumonic density in the left lower lobe, obscured by the cardiac shadow in the postero-anterior view, but visible on oblique and lateral projections. The patient was transferred to the medical service and a diagnosis of lobar pneumonia was made. A blood count taken the same day showed 22,400 white blood cells, with 93 per cent polymorphonuclears and 7 per cent lymphocytes. No significant changes were observed on urinalysis.

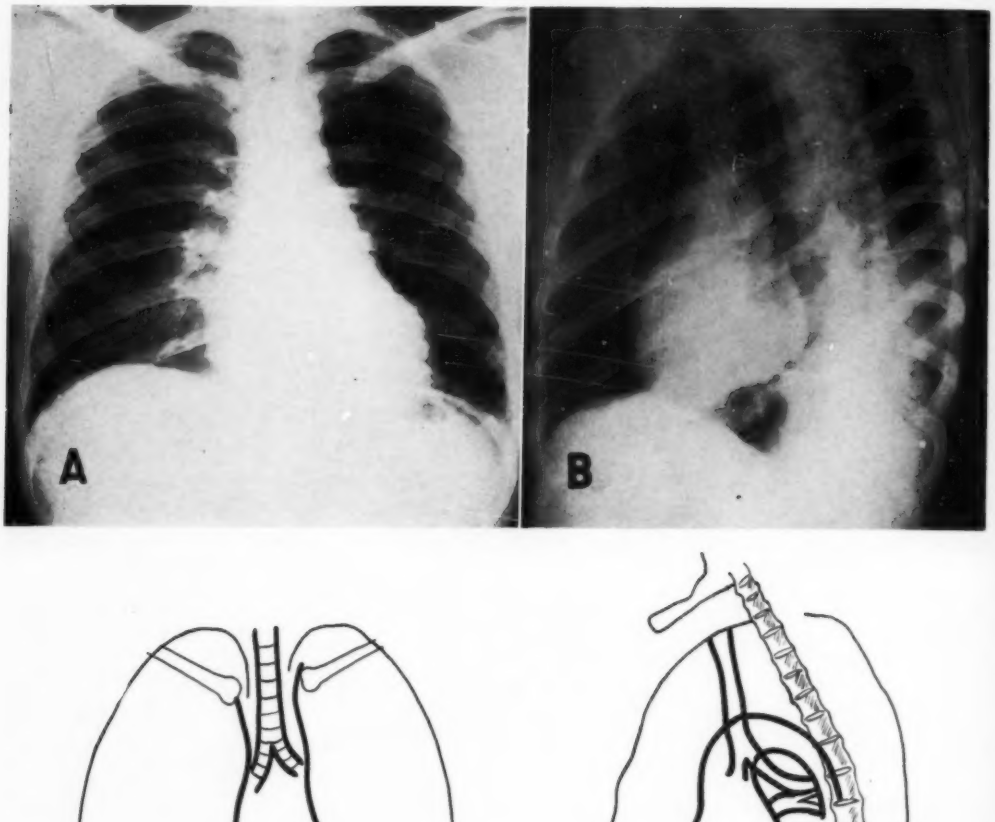

Fig. 3. Case 3: Pneumonic density hidden by the cardiac shadow in the postero-anterior view (A and C) but readily discernible in the left oblique projection (B and D).

Sulfadiazine therapy was administered and resolution of the pneumonic process progressed satisfactorily.

CASE 2: Pvt. R. A. O'D., aged 18, was admitted to the Station Hospital on February 23, 1943, with pain in the left side of his chest, severe chills, cough with expectoration of yellow sputum, malaise, and vomiting. The temperature on admission was 102°, pulse 112, respirations 22. A moderate injection of the pharynx was observed on physical examination. Crepitation in the left cardiophrenic area and numerous harsh rhonchi were heard in the left base. A blood count showed 5,170,000 red blood cells and 18,100 white blood cells with 90 per cent polymorphonuclears and 10 per cent lymphocytes. Urinalysis revealed nothing significant.

X-ray examination of the chest disclosed a pneumonic process involving the right middle lung zone, on a plane with the 5th rib anteriorly. It was requested that oblique and lateral views be taken to rule out an additional pneumonic density behind the heart in the left base.

A Group B, Type 5 pneumococcus was isolated from the patient's sputum on Feb. 24, 1943. Oblique roentgenographic projections taken the same day confirmed the presence of a pneumonic process

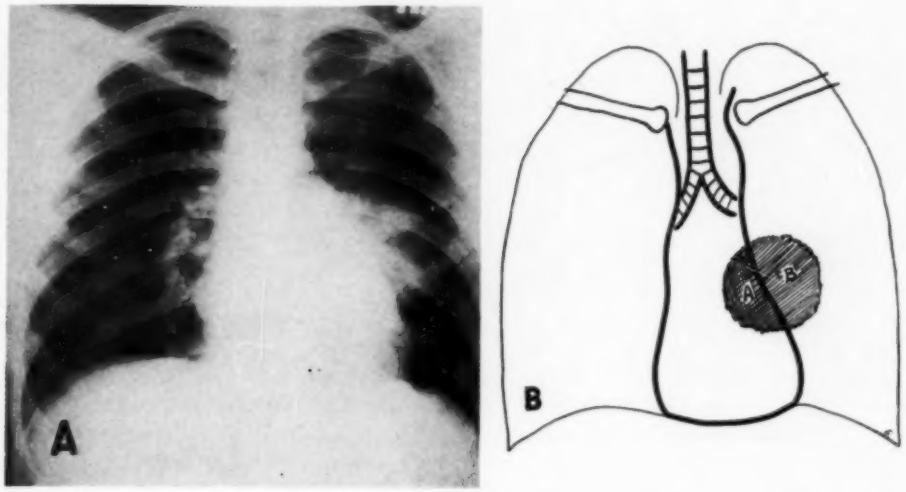

Fig. 4. Case 4: Curious half-moon effect created by that portion of the pneumonic process lying beyond the cardiac shadow. The remaining portion of the process obscured by the heart completes the spherical configuration.

in the left base, previously obscured by the cardiac shadow.

A diagnosis of bilateral lobar pneumonia was made and the patient was given sulfadiazine therapy. Following an uneventful course, he was discharged on March 22, 1943.

CASE 3: Pvt. T. N. M., Jr., aged 20, was admitted to the Station Hospital on Dec. 14, 1942, with cough, weakness, and fatigue, beginning two days previously. Physical examination revealed a slightly injected pharynx, and crepitant râles were heard in both lung bases. The temperature on admission was 104.6°, pulse 104, respirations 24. The blood count showed 11,600 white blood cells. Urinalysis was essentially negative.

X-ray examination of the chest on Dec. 16, 1942, disclosed a density obscured by the cardiac shadow in the postero-anterior projection. Oblique and lateral views taken Dec. 17, 1942, confirmed the presence of the pneumonic process in the left lower lobe.

The patient received sulfadiazine therapy for two days only, followed by routine care. An uneventful recovery ensued.

CASE 4: Pfc. P. J. M., aged 19, was admitted to the Station Hospital on March 26, 1943, with chills, backache, cough, and a sore throat. An injected pharynx was observed on physical examination and râles were heard in the left lung. The temperature was 101.4°, pulse 112, and respirations 24. Urinalysis showed nothing remarkable. The white blood count was 24,650.

X-ray examination of the chest on March 27 revealed a large spherical pneumonic process, involving the left hilum and the upper portion of the left lower lobe area. Sputum examination disclosed no response to typing serum.

The patient was put on sulfadiazine therapy and was discharged on April 11, 1943, following an uneventful recovery.

Note: Appreciation is hereby expressed for the co-operation of Colonel R. M. Allott, Medical Corps, and for the valuble assistance rendered by Major Harold Einhorn, Medical Corps, and Mark Derovan, Technician Fifth Grade.

A.A.F.T.S.
Sioux Falls, S. Dak.

March Fracture of the Tibia[1]

MAJOR GEORGE R. KRAUSE, M.C., A.U.S., and LT. COL. JOHN R. THOMPSON, JR., M.C., A.U.S.

ALTHOUGH "MARCH fractures" of the metatarsals have been encountered with increasing frequency (2, 6, 12, 13), similar "stress" fractures in the other weight-bearing bones are apparently much less common. More than 200 metatarsal march fractures have been observed at the authors' station, but until recently none had been seen in other bones. Three instances of march fracture in the tibia were then encountered within two months, and a search of the files revealed a fourth case.

Pfahler (10) reported a single instance of this type of fracture of the tibia at the meeting of the American Roentgen Ray Society in 1939. This "insufficiency fracture" had occurred in a high-school athlete. The fracture line was narrow, incomplete, and extended only through the thickness of the cortex. The callus resembled an osteogenic sarcoma, and Pfahler stated that up to that time he had never seen a fracture of this kind. Barth, in discussing the report, remarked that no such case had been seen in his clinic. Pfahler commented that such fractures had not been seen in this country because, up to that time, we had not had compulsory military training. In the European literature, on the other hand, as might be expected, a number of reports of march fractures of the tibia were to be found.

Aleman (1) stated that about 100 instances of *periostitis ab exercitio* are reported yearly in the Swedish army. He objected to the name and designated these cases as insufficiency fractures, although he had not observed the fracture line, but only the callus formation.

Ollonqvist (8), basing his report on twelve years of observation, stated that "march fractures" of the tibia occurred at the rate of 60 a year in the Finnish army. He called it *osteopathia tineraria tibiae* and noted the presence of the fracture line. (It is possible that the extensive use of skis and snowshoes in the Northern European armies may have some relation to this large number of incomplete fractures in the tibia.)

Brandt (3) stated that march fractures of the tibia are usually located in the middle third and are next in frequency to those occurring in the metatarsals. He attributed this high incidence in the tibia to the rigid marching step used in the German army.

Hansson (4) reported a case of incomplete fracture of the tibia of this type and two similar fractures in the femur.

In 1942 Peterson (9) recorded a single instance of this type of fracture in the femur, and stated that the only similar cases in the English literature had been reported by Nordentoft (7) in 1941. The latter had described two march fractures in the tibia and two in the femur.

Roberts and Vogt (11), in 1939, described 12 cases of "pseudofracture" of the upper third of the tibia, without a history of trauma, in children ranging from four to sixteen years of age. While the roentgenologic appearance is quite similar to that described by Pfahler, Ollonqvist, and Hansson, the clinical picture differs in certain aspects from that seen in adults. The duration of symptoms in some of the cases was longer, in some there was active infection elsewhere in the body, and in two of them biopsy revealed chronic inflammation. The fractures seem, however, to be of the same type as those to be described in this report. One instance is strikingly similar to Case 4.

Hartley (5) recently reported 14 cases of "fatigue fracture" in the tibia, 3 of which he described in detail. Three patients, one of whom was a young soldier, suffered bilateral fractures. The age range in Hartley's series was much the same as

[1] Accepted for publication in June 1943.

Figs. 1 and 2. Case 1: Anteroposterior and oblique roentgenograms of right leg taken twenty-one days after the onset of symptoms. The anteroposterior view shows the narrow, incomplete fracture line extending through the cortex of the tibia on the medial border (arrow). A small amount of lightly calcified callus is visible in this view. Both the fracture line and callus are seen in the oblique view. The infraction of the cortex is on the posteromedial surface of the tibia at the junction of the upper and middle thirds.

that of the group reported by Roberts and Vogt.

Only two papers in the English literature deal with more than one or two cases of this type of fracture of the tibia and the patients have been, almost without exception, children or adolescents. A possible explanation of the apparently higher incidence in this group may lie in the physical activity of these youngsters.

In the cases described by Pfahler and Peterson, in two of those reported by Hansson, and in three of those mentioned by Roberts and Vogt, a diagnosis of neoplasm of bone was seriously considered. This illustrates the point that the differential diagnosis between osteogenic sarcoma and these incomplete ("fatigue," "insufficiency," "march") fractures is most important. This differentiation did not confuse the issue in the cases reported here because the fracture line was visible on all of our roentgenograms.

The mechanism, as in metatarsal march fractures, is probably a summation of minor, subthreshold traumata incident to marching, to a point beyond the capacity of the bone to bear stress (3, 4).

The most common site of march fractures of the tibia appears to be at the junction of the middle and upper thirds on the medial surface, although they do occur at other sites. The fracture line is usually incomplete and extends only through the cortex. It may be completed, however, by relatively slight injury.

Callus formation is seen early and is a prominent feature. It is often visible

Figs. 3 and 4. Case 2: Anteroposterior and lateral roentgenograms of the left leg. The anteroposterior view, taken five days after the onset of symptoms, demonstrates a narrow "Y"-shaped infraction of the cortex on the medial border of the tibia in its upper third (arrow); no callus is seen. There is an old healed fracture of the fibula incurred at the age of twelve. The lateral view, made one month after onset of symptoms, reveals a large amount of callus, which appears to extend across the shaft of the tibia (arrow). The callus is still fuzzy.

posteriorly, although the fracture line itself cannot be traced all the way. The amount of callus is more than adequate, probably because the gradual onset of symptoms permits continued walking and even full army duty for a time. Recovery is usually uneventful.

In view of the expansion of the armed forces of the United States, and the consequent probable increase in frequency of this type of fracture, the following four cases are submitted to draw further attention to the fact that the tibia is also subject to a march fracture.

CASE REPORTS

CASE 1: A 21-year-old soldier of medium build had had slightly less than three months' army service, when on March 5, 1943, while on a cross-country march, he noticed a dull pain in the upper half of the right leg anteriorly. This pain was present with each step and gradually became worse, so that he had to fall out. Relief from pain was obtained as long as he did not bear weight on the right leg. Further attempts at walking caused recurrence of the pain. He was placed on quarters and instructed to rest the leg. Five days later swelling was present over the entire anterior surface of the tibia. The relationship of the pain to weight-bearing was more pronounced.

Ten days after the onset he was admitted to the hospital with the tentative diagnosis of osteomyelitis. Physical examination revealed edema over most of the anterior surface of the leg, with tenderness at the junction of the middle and upper thirds. Roentgenograms revealed a narrow incomplete fracture line on the medial aspect of the tibia at the junction of the upper and middle thirds.

Other roentgenograms (Figs. 1 and 2) eleven days later (twenty-one days after the onset) showed definite callus formation. The fracture line was still visible.

Comment: This is a typical history of a minor infraction of the cortex resulting from marching and follows in every detail the history usually obtained in similar fractures of the metatarsals, varying only in the site of pain.

CASE 2: A 28-year-old soldier of slender build first complained of pain on the lateral aspect of the left leg on Jan. 9, 1941, during calisthenics (running-in-place exercise). At that time he had had three months' service in the army. The pain was not severe and was present only on motion of the leg and on weight-bearing. He continued with his duties for the following few days, but the pain gradually became more severe and the relation to weight-bearing very evident. A roentgenogram made on Jan. 14 (Fig. 3) showed a tiny incomplete fracture of the cortex of the medial border of the tibia about 5 cm. from the articular surface. The fracture line was not recognized by the officer in charge of the department at that time.

The patient continued on duty and two days later noticed slight edema and tenderness just below the left knee joint on the anterior aspect. He was then admitted to the Station Hospital. Physical examination was negative, except for definite tenderness in the area mentioned.

Another roentgenogram on Feb. 9 (Fig. 4), one month after the onset, showed definite lightly calcified callus at the site of the fracture line, which was now easily recognized. The patient made an uneventful recovery.

Comment: This is a typical example of a fracture of the cortex of the tibia, in the absence of a single direct trauma, in a soldier undergoing basic training. The fracture line was so narrow that it was overlooked on the first examination, but the nature of the injury was clearly evident when callus formation was seen. The clinical history was characteristic.

CASE 3: A 24-year-old soldier of slender build had had three months of army service, when early in April of 1943 he noticed a small area of ecchymosis over the lower portion of the right tibia. There was no pain and the discoloration disappeared in two days. He had neither bumped nor injured his leg in any manner. Three days later he experienced pain in this area while marching. This gradually became worse, and after a week a small lump (callus) was palpable. He continued on duty but the pain became worse, especially on long marches. During rest periods a dull ache was present. The patient first reported to his unit dispensary on May 5, 1943, and was sent to the hospital for roentgenographic study. Roentgenograms taken that day and on May 7 (Fig. 5) revealed a narrow, incomplete fracture line through the cortex of the lower third of the tibia on the medial side. A cap of well demarcated callus covered the fracture.

Fig. 5. Case 3: Anteroposterior roentgenogram of the right leg made one month after the onset of symptoms, showing an oblique fracture through the cortex of the medial surface of the tibia in the lower third. A cap of well defined callus covers the fracture.

Comment: This is a characteristic story of an incomplete fracture, in this instance in the lower third of the tibia. It resembles the preceding two cases, varying only in the location of the fracture. The patient was first examined one month after the onset of symptoms, at which time both the callus and the fracture line were demonstrable.

CASE 4: A stocky 25-year-old soldier, having had 2 months' army service, was first admitted

Fig. 6. Case 4: Anteroposterior roentgenogram of the right leg, showing an oblique, complete fracture through the distal and middle thirds of the tibia. There was no direct injury to the leg, and the patient denies twisting it in any fashion. This fracture occurred spontaneously during marching. Bone texture is normal. Healing was uneventful.

to the Station Hospital on Jan. 12, 1943, complaining of pain in the left foot. This was aggravated by walking and there was a slight edema of the dorsum of the left foot. Roentgenograms revealed a march fracture of the third *left* metatarsal, which was treated by rest, physiotherapy, and a metatarsal bar. The patient was discharged from the hospital on Feb. 13, with the fracture healed. On Feb. 15 he participated in the usual company training, including drill. Toward the end of the day he noticed a dull ache on the anterior portion of the *right* tibia. Routine drill and duty activities aggravated the pain, which was still not severe and was present only while bearing weight on the right leg. On the morning of Feb. 17, during "double-time" marching, the pain became worse, but was still present only on weight-bearing. The patient was forced to fall out. After a short rest he returned to the drill, but the pain persisted. A few minutes later he experienced a sudden sharp pain in the lower third of the leg, heard a loud snap, and fell to the ground, unable to walk.

Roentgenograms of the right leg (Fig. 6) revealed an oblique, complete fracture through the tibia in its distal third. The position was excellent. The leg was placed in a plaster cast. Recovery was uneventful.

Comment: The extent of the fracture in this case is far greater than in any of the three preceding cases, being of such extent as to cast doubt on the diagnosis of "march fracture." The patient, however, is emphatic in his statement that he did not twist his leg in any manner. The gradual onset of the pain, the progressive severity, and the definite relation to marching and weight-bearing also indicate that this is a fracture associated with marching. It is possible that the fracture was at first incomplete, and was due to continued marching, but that torque supplied by a minor twist of the leg was sufficient to convert it into the form seen in Figure 6.

SUMMARY

Attention has been called to the fact that march fractures may occur in the tibia. These fractures will probably be seen in increasing frequency in the armed forces. The fracture line is usually quite narrow and must be sought carefully. Callus formation is seen early. The history is quite similar to that obtained in march fractures of the metatarsals, varying only in the site of pain. Four cases are reported.

1313 Maple St.
Columbia, S. C.

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March Fracture of the Inferior Pubic Ramus: A Report of Three Cases[1]

MAJOR DEAN B. JONES, M.C., A.U.S.

AT ALL ARMY POSTS there have developed considerable interest in, and speculation about, the nature of march fractures. Three cases involving the inferior pubic ramus are being recorded here which have been characterized by absence of any history of trauma, absence of any other break in the pubic ring, and roentgenographic findings believed to be indicative of march fracture. These same cases are included in a comprehensive study of "March Fractures" to be published by the Chief of the Orthopedic Section of this hospital, in another journal.

CASE REPORTS

CASE 1: An infantryman, aged 34 years, had been in service approximately three and a half months. He had been engaged in simulated combat maneuvers and during this rather strenuous activity began to experience some pain along the adductor aspect of the left thigh. There was no history of trauma; rather one of slow insidious development. About six weeks after onset the pain radiated as far as the perineal region, and the patient came to the Clinic for examination. A course of physiotherapy was prescribed, but he failed to improve and further examination revealed marked tenderness close to the pubic bone. Roentgenograms revealed a rather broad hazy line of decreased density traversing the left inferior pubic ramus, in a vertical direction, with an area of periosteal proliferation at its proximal extremity close to the periphery of the obturator foramen (Fig. 1). No other break in the pubic ring was present. The patient was hospitalized and made a complete symptomatic recovery with simple bed rest.

CASE 2: An infantryman, aged 25, came to the Clinic complaining of pain along the adductor aspect of the right thigh. As in Case 1, the onset was insidious and could not be related to any acute traumatic incident, nor was there any response to a regimen of physiotherapy. Roentgenograms again showed a zone of rarefaction and surrounding periosteal reaction in the region of the mid-portion of the inferior ramus of the pubis, at the site of origin of the adductors (Figs. 2 and 3). The patient made a satisfactory recovery following simple bed rest.

[1] From the Department of Roentgenology, Station Hospital, Camp Maxey, Texas. Accepted for publication in July 1943.

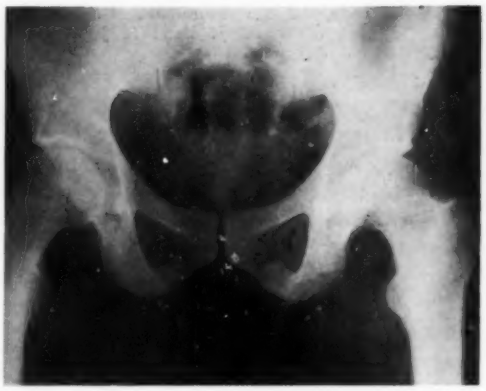
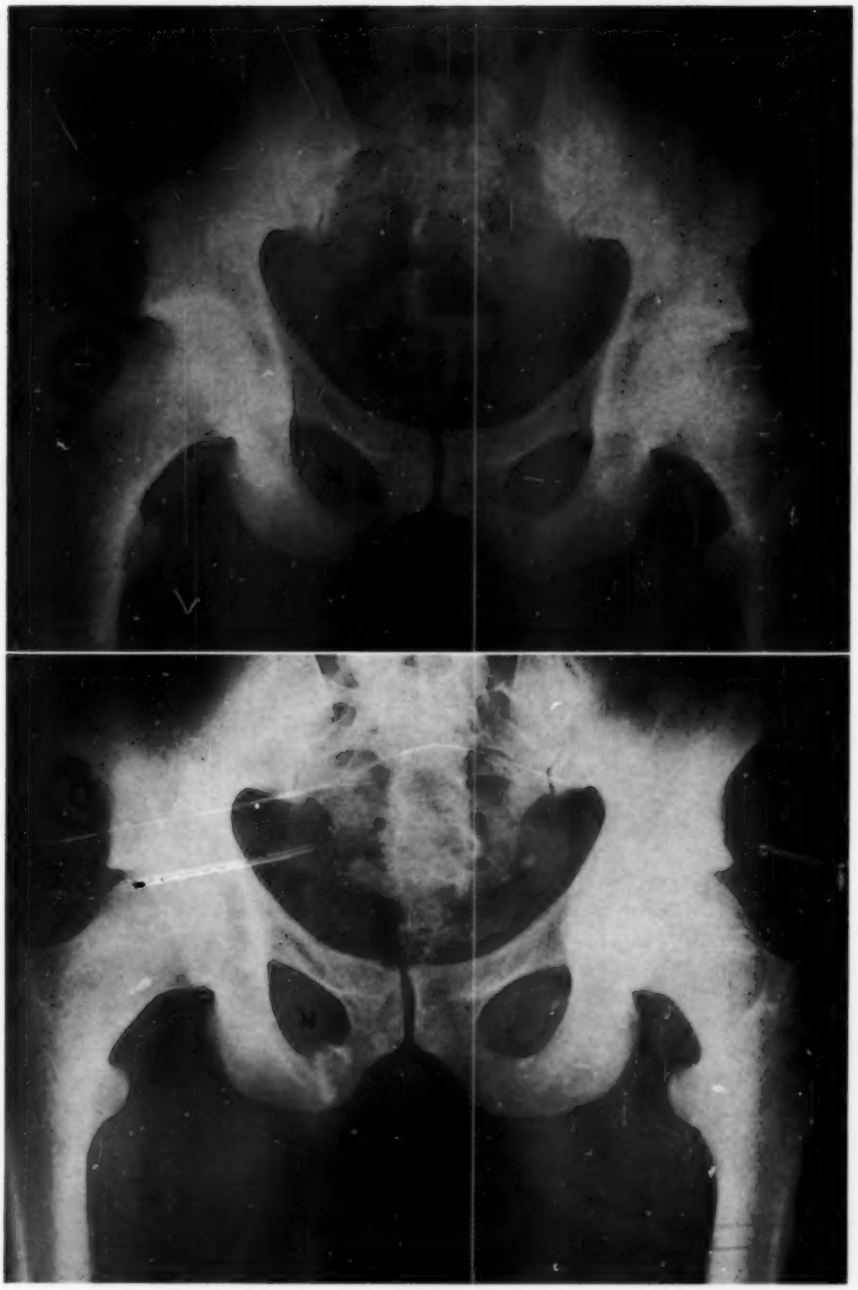


Fig. 1. Case 1: Roentgenogram showing broad hazy line of decreased density transversing the left inferior pubic ramus.

CASE 3: This case was similar in all essential respects to the other two. A soldier, aged 26, who gave no history of trauma to the pubis or any portion of the pelvis, complained of pain in the adductor region. Roentgenograms of the pelvis revealed a later stage of the previously described process with productive change in the region of the inferior ramus, replacing to some extent the rarefaction which was prominent in the earlier cases (Fig. 4).

COMMENT

Three cases are presented showing rarefaction across the inferior ramus of the pubis with a zone of periosteal proliferation at the margins, the periosteal reaction being most prominent on the upper margin of the ramus. The only case previously discovered in a superficial survey of the literature is that of Wilhelm (2), in which the roentgen appearance was, in all respects, comparable to that in the cases reported here. This case appeared in the German literature, and was discovered in a member of the German Army before our relations became less cordial. The author stated that these and all "march" or "insidious" fractures occurred in young men of previous sedentary existence who were suddenly introduced into rigorous



Figs. 2 and 3. Case 2: Fracture of right inferior pubic ramus. The lower roentgenogram was made some time after the upper.

Fig. 4. Case 3: Fracture of left inferior pubic ramus first observed in a later stage than Cases 1 and 2.

military training. The fractures occurred in the young trainees and not in the older, trained and conditioned soldiers. These criteria were present in our cases also.

Brandt (3), also in the German literature, though not describing this particular fracture, states that these lesions occur "insidiously as result of rhythmically repeated, subthreshold, mechanical insults, which only by summation lead to structural changes and severance of continuity." He lists the following synonyms: "transformation zones, callous tumors, fractureless callus, overload injuries, exhaustion fractures, and insufficiency diseases."

The main practical point to be kept in mind, especially by the Army orthopedist and roentgenologist, is that in the presence of adductor, hip, or pelvic pain, a check by roentgenogram of the pelvis should be a part of the examination. We feel sure this condition will be found frequently in the Armed Forces, if it is frequently sought.

Station Hospital
Camp Maxey, Texas

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Basilar Impression: The Position of the Normal Odontoid[1]

WM. W. SAUNDERS, M.D.

San Francisco, Calif.

In 1939 W. E. Chamberlain (1) called attention to the syndrome of basilar impression, which had been described in the European literature (2–4) years before. The syndrome includes symptoms mimicking syringomyelia, progressive spastic paralysis, or multiple sclerosis in the region of the upper cervical cord and medulla, and a shortening of the neck. The roentgenogram shows deformities of the foramen magnum and anomalies of the base of the skull, the atlas, and axis, sometimes including fusion of the bodies of some of the upper cervical vertebrae, and often fusion of the anterior arch of the atlas to the occipital bone. Since 1939 enough additional cases have been reported to indicate that the condition is not excessively rare. The symptoms can often be relieved by surgery. It becomes a matter of some importance, therefore, to set up proper diagnostic criteria.

Chamberlain points out that the final diagnosis must usually be made by the radiologist on the basis of changes in the relations at the base of the skull, including displacement of the atlas and the tip of the odontoid above their normal position, which he states is entirely below a line joining the posterior margin of the hard palate with the dorsal margin of the foramen magnum.

This dictum has been used as an important criterion, notably by Walsh, Camp, and Craig (5) and by Laube and Turner (6). The former authors have christened the determining line the "Chamberlain line." Before this criterion is finally accepted, however, the range of position of the tip of the odontoid in the lateral roentgenogram of normal persons needs to be established.

Since basilar impression is so rare, the general run of patients having skull examinations may be considered normal in this respect and can properly be used as controls. We have chosen from among our latest examinations 100 lateral skull films on which no roentgen diagnosis of disease could be made. In none of these cases were there symptoms at all suggestive of the syndrome of basilar impression. The position of the tip of the odontoid process was carefully measured with respect to a line joining the dorsal margin of the hard palate with the dorsal margin of the foramen magnum. Table I gives the results arranged by 1-mm. intervals, the minus sign indicating that the tip of the odontoid lies below the reference line and the plus sign above.

Table I: Position of the Tip of the Odontoid with Respect to "Chamberlain's Line" in 100 Normal Persons

Mm.	No. of Cases	Mm.	No. of Cases
+8 (above)	1	− 2 (below)	10
+7	1	− 3	7
+6	0	− 4	8
+5	3	− 5	6
+4	5	− 6	5
+3	8	− 7	2
+2	8	− 8	2
+1	9	− 9	0
0	13	−10	1
−1 (below)	10	−11	1

Note: Direct measurement from films. Anode-film distance 36 inches.

The arithmetical mean position of the top of the odontoid in the normal roentgenogram is, therefore, about 1 mm. (0.94) below the reference line. The standard deviation is 3.6 mm. The normal probability curve corresponding to these coordinates is seen to lie close to the plot of the crude data. One may then use the normal curve to calculate the probability that the tip of the odontoid will lie above

[1] From the Division of Radiology, Stanford University School of Medicine. Accepted for publication in February 1943.

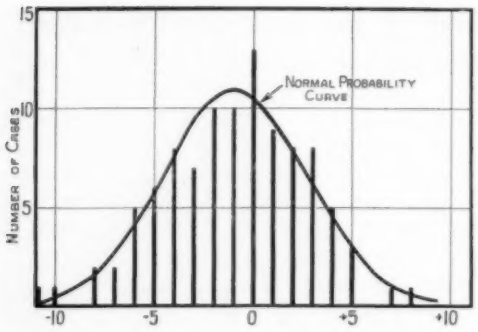

Fig. 1. Position of the tip of the odontoid in 100 normal skull roentgenograms: millimeters above (+) or below (−) the hard palate-foramen magnum line.

the reference line by varying amounts, as follows:

1 in 5 will lie more than 2 mm. above the line.
1 in 19 will lie more than 5 mm. above the line.
1 in 64 will lie more than 7 mm. above the line.
1 in 800 will lie more than 10 mm. above the line.

CONCLUSIONS

1. The average position of the tip of the odontoid in the normal lateral skull film is 1 mm. below "Chamberlain's line."

2. Only reasonably large deviations above the line are significant of abnormality. A smaller deviation should suggest the possibility of basilar impression and should call for special examination of the foramen magnum, when necessary, to make the diagnosis.

SUMMARY

The position of the tip of the odontoid on 100 lateral skull films of "normal" patients was found to be 1 mm. below a line from the dorsum of the hard palate to the dorsum of the foramen magnum, with a standard deviation of 3.6 mm.

Acknowledgment: I wish to thank Dr. R. R. Newell for his encouragement and advice and Dr. Sydney F. Thomas for his active assistance.

12 Camino Encinas
Orinda, Calif.

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EDITORIAL

Howard P. Doub, M.D., Editor

John D. Camp, M.D., Associate Editor

The Palliative Point of View about Cancer

The existent attitude of the laity and of many physicians toward the control and cure of cancer apparently is an unaltered relic of medieval superstition. The conception of cancer as an incurable disease is widely accepted by many people, including not a few physicians, in spite of the laudable educational efforts of the American Society for the Control of Cancer and other organizations toward dispelling this belief. It is true that some individual cancers are incurable and the hopelessness in the given case may be recognized and pronounced by the physician at the initial examination, yet the published figures of thousands of cancer cures should exert an influence in changing this point of view toward cancer as a whole, even with the most dismal pessimist.

The diagnosis of arteriosclerosis, chronic nephritis, diabetes mellitus, myocarditis, coronary vascular disease, osteitis deformans, and many other degenerative conditions is accepted with equanimity, fortitude, and optimism by the majority of patients, and yet in the category of end-results of treatment they are all *incurable* diseases. Even in cases of tuberculosis or of pernicious anemia, one refers to an arrest rather than to a cure. When confronted with one of these incurable conditions in his own person, the patient asks of his physician only that treatment which lies within the realm of possibility, hoping that it will successfully arrest the process for the time being, avoid the complications and disabilities attendant on the disease, and prolong his life in comfort. Not so is the attitude of the same patient and his family if the diagnosis be cancer as, in this event, nothing short of a guarantee of cure seems to suffice. An expression by the physician of a reasonable doubt concerning an ultimate cure or a statement covering the statistical chances (if less than 100 per cent) frequently leads to a profound and unreasonable reaction, in which a decision is made to refuse all treatment, surgical or radiological. In other words, palliative treatment is eagerly accepted for all incurable diseases except cancer; its employment for cancer is generally regarded with skepticism and without enthusiasm. In the eyes of the family, the patient is practically dead the moment a pronouncement of incurability is made.

The medical profession has not been faultless in this regard. The accent has constantly been on cure rather than palliation; naturally this is a commendable effort. Published figures on the end-results of treatment from institutions, surgeons, and radiologists specializing in cancer therapy, usually present as the culmination or reward for their efforts, the percentages of so-called five-year cures, or survivals without recurrence for five years. Such figures may vary from 10 to 90 per cent of the cancers treated, depending on the regions involved, stage of the disease, histological types, etc. The reader accepts this figure as the sole expression of life salvage in the group of patients studied. If an economist were to analyze the same data, he would undoubtedly devote some attention to the great group of cases, which are usually summarily dismissed from consideration as failures of cure. This analysis would bring to light and properly accredit the palliative benefits

derived in the short-term (less than five-year) survivors.

If radiological and surgical treatments do prolong the lives of incurable cancer patients, there should be some means of expressing the advantage in a statistical manner, and such results should be duly published. Only in such a way can comparable results of palliative treatment be properly evaluated and improved. One method is to determine, for each regional variety of cancer, the average length of life without treatment, from the time of onset of symptoms to death. Daland and Nathanson have done this for cancer of the breast, and the figures they have provided for the percentages of patients living without treatment for one, two, three, four, and five years can be plotted in a curve, which constitutes a "natural yardstick" against which the cancer therapist can plot the results of palliative treatment of breast cancer. Similar yardsticks for measurement of the average duration of life without treatment should be plotted for cancers of all regions and organs. The general acceptance of such tables would afford all hospitals and physicians treating cancer an opportunity to determine the palliative value of any treatment they are wont to use.

The prolongation of life itself is, of course, not the only measure of palliation. No one wishes to live longer in order to suffer more. The indications for palliative efforts are the relief of pain and discomfort, the healing of ulcerated lesions, the lessening of hemorrhage and infection, the repair of certain pathological fractures, the healing of metastases in bone, the eradication of cough and dyspnea, the restitution of sleep, the delay in generalization of the cancer, and many other well known and admitted benefits of treatment chiefly by radiation methods. It is possible that well judged and appropriate irradiation, for example, might accomplish one or all of the above enumerated benefits without prolonging the life of the individual, yet who would deny that such efforts are worthwhile.

Surgical measures which have been employed for palliative purposes are resection of offensive cancers which are infected, foul, bleeding, or obstructed, the abolition of pain by the severance of sensory nerve tracts or by the injection of alcohol into proper nerves, and the relief of obstruction by short-circuiting operations chiefly on the gastro-intestinal and urological systems. Radiologists have an even greater scope for their palliative efforts in the use of x-rays and radium, the only known agents to effect the cure and palliative relief of cancer with the preservation of the tissues which contain the cancer. Surgery may divorce the patient from his cancer, but does so by amputating a member or removing a part or a whole of the organ involved, providing the organ is not essential to life and the cancer has not disseminated. Strictly speaking, the ideal cure is the destruction of the cancer with preservation of the host tissues, and radiation therapy is the nearest, in fact the only method devised to date which approaches this principle. Radiologists should report the results of radiation therapy not only in the cure of cancer, but in palliative relief, in which field they have little competition.

GEORGE T. PACK, M.D.

DALLAS-FORT WORTH ROENTGEN CLUB

The recently organized Dallas-Fort Worth Roentgen Club extends a cordial invitation to all radiologists, especially those who are located at nearby Army Camps, to attend its meetings. The meetings, which are held on the third Monday of each month, are strictly informal, being preceded by dinner at 7:30. General problems of interest to radiologists are discussed and films of interest are shown. The Club meets in Dallas in the odd months and in Forth Worth in the even months of the year.

Dr. J. R. Maxfield, Jr. (Medical Arts Building, Dallas), president of the Club, or Dr. X. R. Hyde (Medical Arts Building, Fort Worth) will be glad to furnish information regarding the meetings to anyone who may be interested.

Books Received

THE 1943 YEAR BOOK OF RADIOLOGY. Diagnosis edited by CHARLES A. WATERS, M.D., Associate in Roentgenology, Johns Hopkins University; Assistant Visiting Roentgenologist, Johns Hopkins Hospital, and WHITMER B. FIROR, M.D., Assistant in Roentgenology, Johns Hopkins University; Assistant in Roentgenology, Johns Hopkins Hospital. Therapeutics edited by IRA I. KAPLAN, B.Sc., M.D., Director, Radiation Therapy Department, Bellevue Hospital, New York City; Associate Radiologist, Lenox Hill Hospital, New York City; Clinical Professor of Surgery, New York University Medical College. 456 pages and 378 illustrations. Published by The Year Book Publishers, Inc., Chicago, Ill., 1943. Price $5.00.

In Memoriam

JOHN A. HERRING, M.D.
1891–1943

Dr. John A. Herring of St. Petersburg, Florida, died after a brief illness on Nov. 17. Doctor Herring was born in Georgetown, Ky. He was a graduate of the Medical School of the University of Michigan and served his internship in St. Luke's Hospital, New York. After teaching for a brief period in Cornell University and in the University of Michigan, he specialized in roentgenology. Since 1925 he had practised in St. Petersburg, serving on the staffs of Mound Park and St. Anthony's Hospitals. He was a member of the Radiological Society of North America.

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit, 2 Mich.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Building, Syracuse, N. Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 540 N. Michigan Ave., Chicago, Ill.

Section on Radiology, American Medical Association.—Secretary, J. T. Murphy, M.D., 421 Michigan St., Toledo, Ohio.

ARKANSAS

Arkansas Radiological Society.—Secretary-Treasurer, J. S. Wilson, M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Joseph D. Coate, M.D., 434 Thirtieth St., Oakland.

Los Angeles County Medical Association, Radiological Section.—Secretary, Donald R. Laing, M.D., 65 N. Madison Ave., Pasadena. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary-Treasurer, L. Henry Garland, M.D., 450 Sutter St., San Francisco. Society meets annually during annual meeting of the California Medical Association.

San Francisco Radiological Society.—Secretary, Sydney F. Thomas, M.D., San Francisco Hospital. Meets monthly on third Thursday at 7:45 P.M., in Toland Hall, University of California Hospital.

COLORADO

Denver Radiological Club.—Secretary, Edward J. Meister, M.D., 366 Metropolitan Bldg. Meetings third Friday of each month at the Denver Athletic Club.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary-Treasurer, Max Climan, M.D., 242 Trumbull St., Hartford. Meetings bimonthly, on second Thursday. Place of meeting selected by Secretary.

FLORIDA

Florida Radiological Society.—Acting Secretary, Walter A. Weed, M.D., 204 Exchange Building, Orlando.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta. Meetings twice annually, in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, Warren W. Furey, M.D., 6844 S. Oglesby Ave. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, M.D., Louisville City Hospital, Louisville. Meeting annually in Louisville, third Saturday afternoon in April.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

Shreveport Radiological Club.—Secretary-Treasurer, R. W. Cooper, 940 Margaret Place. Meetings monthly on the second Wednesday, at the offices of the various members.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Walter L. Kilby, M.D., 101 W. Read St Meetings are held the third Tuesday of each month.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

Michigan Association of Roentgenologists.—Secretary-Treasurer, E. M. Shebesta, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement

MINNESOTA

Minnesota Radiological Society.—Secretary, John P. Medelman, M.D., 572 Lowry Medical Arts Bldg., St. Paul. Meetings quarterly.

MISSOURI

Radiological Society of Greater Kansas City.—Secretary, Arthur B. Smith, M.D., 306 E. 12th St., Kansas City. Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—Secretary, Paul C. Schnoebelen, M.D., 462 N. Taylor Ave. Meets on fourth Wednesday of each month except June, July, August, and September, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—Secretary, F. L. Simonds, M.D., 1216 Medical Arts Bldg., Omaha. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society (Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island).—*Secretary,* Hugh F. Hare, M.D., Lahey Clinic, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW JERSEY

Radiological Society of New Jersey.—Secretary, H. J. Perlberg, M.D., Trust Co. of New Jersey Bldg., Jersey City. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—Secretary, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—Secretary-Treasurer, Leo Harrington, M.D., 880 Ocean Ave. Meetings held the fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—Secretary-Treasurer, Joseph S. Gianfranceschi, M.D., 610 Niagara St. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen Ray Society.—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings are held in January, May, and October, as called by Executive Committee.

Long Island Radiological Society.—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—Secretary, Haig H. Kasabach, Presbyterian Hospital, New York, N. Y.

Rochester Roentgen-ray Society.—Secretary, S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meeting with State meeting in May, and meeting in October.

NORTH DAKOTA

North Dakota Radiological Society.—Secretary, L. A. Nash, M.D., St. John's Hospital, Fargo. Meetings by announcement.

OHIO

Ohio Radiological Society.—Secretary, J. E. McCarthy, M.D., 707 Race St., Cincinnati. The next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—Secretary-Treasurer, Don D. Brannan, M.D., 11311 Shaker Blvd., Cleveland 4. Meetings at 6:30 P.M. on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*Secretary-Treasurer,* Samuel Brown, M.D., 707 Race St. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport. The Society meets annually.

The Philadelphia Roentgen Ray Society.—Secretary, Robert P. Barden, M.D., 3400 Spruce St., Philadelphia. Meetings held first Thursday of each month at 8:15 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—Secretary-Treasurer, Reuben G. Alley, M.D., 4800 Friendship Ave., Pittsburgh, Pa. Meetings are held on the second Wednesday of each month at 4:30 P.M., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota, South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—*Secretary,* A. M. Popma, M.D., 220 North First St., Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—Secretary-Treasurer, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston. Meeting in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—Secretary-Treasurer, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—Secretary-Treasurer, Herman Klapproth M.D., Sherman.

VIRGINIA

Virginia Radiological Society.—Secretary, E. Latané Flanagan, M.D., 215 Medical Arts Bldg., Richmond.

WASHINGTON

Washington State Radiological Society.—Secretary-Treasurer, Thomas Carlile, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday of each month, October through May, at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—Secretary-Treasurer, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee. Meets monthly on second Monday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, Russell F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

CANADA

Canadian Association of Radiologists.—Honorary Secretary-Treasurer, A. D. Irvine, M.D., 540 Tegler Bldg., Edmonton, Alberta.

La Société Canadienne-Française d'Eléctrologie et de Radiologie Médicales.—General Secretary, Origène Dufresne, M.D., Institut du Radium, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

The Cranial Seriograph and Its Utility in Neurologic Radiology for Cerebral Angiography. J. M. Sanchez-Perez. Surgery **13:** 661–666, May 1943.

The author has in previous communications described the method of making complete cerebral angiograms by means of the "escamoteador," originally conceived by Egas Moniz. He has himself devised a new portable apparatus, adapted to any x-ray table and much easier to handle. This apparatus, which he calls a seriograph, is constructed for use with 10 × 12-in. films. It consists of a box 15 × 12.5 × 4 in. containing vertical steel springs and a platform accommodating three identical trays or cassette carriers one above the other, each containing a thin sheet of lead for protection of the underlying films. The cover of the box has on its superior surface a Lysholm grid. A lead-lined compartment is provided for receiving the cassettes after exposure.

The seriograph is placed at one end of the x-ray table, the tube is centered at a distance of 40 inches so that the central rays will pass through the center of the films, and the patient is placed on the table in the supine position with the head resting on the box. After exposure of the common carotid artery, 6 c.c. of radiopaque substance (diodrast or thorium dioxide) is injected and at the instant the injection is complete the initial film is exposed. This is the arteriogram. The first tray and its cassette are then removed and after one and one-half seconds the second film is exposed. This is a "phlebogram of the first phase." After a lapse of another second and a half the third exposure is made, the "phlebogram of the second phase."

The author cites briefly three cases to illustrate the importance of complete angiography. In the first a huge aneurysm of the internal carotid was demonstrable on the arteriogram only. In the second the arteriogram was difficult to interpret but the phlebogram of the first phase (the second film) showed clearly a shadow indicating a metastatic cerebral tumor, confirmed at necropsy. In the third case a meningioma was shown only in the second phase phlebogram.

J. E. WHITELEATHER, M.D.

Paraphysial Cysts of the Third Ventricle: Diagnosis and Surgical Management. Laurence M. Weinberger and Benjamin Boshes. Surgery **13:** 368–384, March 1943.

The authors have found in the literature sixteen accounts of paraphysial cysts successfully removed. They present the significant details of these cases in tabular form, add a seventeenth example, and review the diagnostic and surgical methods which have been employed.

Their patient was a 22-year-old woman who had been entirely well until approximately three weeks before admission, when she was awakened one morning by an agonizing headache followed by vomiting. The headache gradually disappeared but recurred each succeeding day. It involved mainly the frontal and occipital areas and was described as "pushing" or "pressing." It was intensified in the supine position. Shortly before admission the patient began to experience attacks of pain in the back of the neck, radiating down into the shoulders and arms and accompanied by numbness of the hands. Finally double vision developed. Examination revealed palsy of both external recti muscles, bilateral papilledema, and flame-shaped retinal hemorrhages. The visual fields were full; visual acuity was 20/30. Ventriculography showed dilatation of both lateral ventricles, especially the left. The third ventricle was not demonstrable in any position. The air shadows in both lateral ventricles were sharply cut off. A diagnosis of tumor occupying the anterior portion of the third ventricle was made.

At operation, performed as an emergency measure, the foramen of Monro was found to be collapsed. At its orifice appeared a glistening tumor, which was grasped by a forceps and slipped through the foramen into the third ventricle. The tumor was the size of a small cherry and appeared to be a thin-walled translucent cyst with fine vessels traversing the surface. It was separated from the choroid plexus to which it was attached and was removed. The septum lucidum was punctured to insure drainage from the right to the left ventricle and a Penrose drain was placed within the lateral ventricle and brought out through the dural flap. At the end of four months the patient had almost fully recovered. The visual acuity was 20/20, visual fields were full, there was no optic atrophy, and neurological examination was negative except for a slight weakness at the left angle of the mouth.

Paraphysial cysts are now recognized as arising from the paraphysial body, an ancient gland situated in the mid-line of the rostral portion of the roof of the third ventricle. It is found in all vertebrates and in the human embryo appears on about the seventy-fifth day of gestation and disappears shortly thereafter. In some persons, remnants of the gland apparently persist throughout fetal life and presumably enlarge slowly during postnatal existence by retention of the products of the secreting epithelial cells. If growth continues, the cyst enlarges until it occupies and fills the anterior portion of the third ventricle, eventually obstructing the intraventricular foramina. Both foramina are likely to be blocked equally, resulting in a dilatation of the lateral ventricles, which is generally symmetrical. Gradual dilatation from an incomplete block may occur and yet cause no symptoms. The onset of violent headache, vomiting, and papilledema occurs when the block becomes complete. Impaction of the tumor into one or both foramina may occur for transient periods, marked by episodes of increased intracranial hypertension, which may subside abruptly. The explanation of this curious phenomenon is that there is a certain degree of mobility to these pendulous tumors which hang from the roof of the third ventricle. A change in position may dislodge the tumor enough to obstruct the foramina suddenly and completely. Venostatic edema of the basal ganglia as well as an increased secretion of fluid due to the raised venous pressure in the plexus may result from compression of the lesser veins of Galen in the foramina. Sudden death is not an uncommon ending to these episodes.

Not only is a syndrome diagnostic of these tumors lacking but a review of the literature reveals that they may exist without producing evidence of intra-

cranial hypertension, although they cause other ominous symptoms. Slowly progressive dementia, a chronic convulsive state, primary optic atrophy, and other symptoms not ordinarily ascribed to intracranial pressure may comprise the clinical picture.

Histories of cases show so many vagaries that little is obtained for diagnostic purposes from a study of the records. The first manifestations may announce themselves with apoplectiform rapidity, sudden coma, and death. On the other hand, evidence of what appears to be diffuse degeneration of the nervous system may exist for years. Diagnosis rests upon evidence afforded by pneumography.

The pneumographic findings vary somewhat, depending upon the completeness of the intraventricular foraminal block and the integrity of the septum lucidum, the type of air study, and whether one or both ventricles are punctured in the performance of ventriculography. Encephalography is, in the opinion of most neurosurgeons, hazardous. If both the lateral ventricles are cannulated a characteristic ventriculogram is obtained, both the ventricles appear dilated, and no air is seen within the third ventricle in any position. The foramina of Monro are dilated. Occasionally the outline of the tumor may be seen bulging into one or both lateral ventricles. If only one lateral ventricle is cannulated and the septum lucidum is intact, only one ventricle will show. If the septum is frayed or torn, the air may pass through and both ventricles will fill. Since either of these observations may lead to misinterpretation, the authors favor injection of both ventricles with air at the same time.

Operation should be undertaken when the ventriculographic diagnosis is made, as disaster may otherwise occur. Many approaches have been made, but the author favors a transcortical route, which is deemed less hazardous than the transcallosal route. Since the tumors lie exactly in the mid-line there is no occasion for an approach from the left, which may produce aphasic disturbances or defects in spatial orientation. The author believes the operation should be performed in one stage. Ample working room is usually obtained within the dilated lateral ventricle; the structures are seen clearly, and the foramen of Monro may be found promptly by following the choroid plexus forward until it disappears. The cyst, if large, presents itself as a greenish or bluish mass in a dilated foramen. If small, it may not be visible and the foramen may appear as a small slit. By tugging gently on the choroid plexus, the cyst wall can be brought into view in the aperture of the foramen and then grasped with an instrument. Some operators have first evacuated the contents of the cyst by aspiration and others have enlarged the foramen by slitting the margin. The slit can be made safely only in the anterior rim of the foramen, which is formed by the descending pillars of the fornix.

Since manipulations around the foramen may produce edema and thus obstruct the drainage of the ventricles, it is worth while to take the precaution of opening the septum lucidum, if an opening is not already present. Drainage for a few days may prevent cerebral swelling and remove blood and detritus from the ventricle. If the incision through the cortex is placed well anterior to the motor strip, complete recovery should follow operation, since removal of the tumor ordinarily entails no trauma to vital structures.

J. E. WHITELEATHER, M.D.

Case of Associated Facial and Intracranial Hemangioma. L. B. Shapiro. Illinois M. J. **83:** 272–274, April 1943.

A case of associated facial and intracranial hemangiomata is presented. The clinical findings were a left-sided facial nevus, localized jacksonian convulsive seizures involving the right lower extremity, urinary incontinence, and roentgen evidences of calcification in the occipital cortex.

The author prefaces his report with a review of the literature. Greenwald and Koota (Am. J. Dis. Children **51:** 868, 1936) in a survey of 81 published cases found convulsive seizures, generally jacksonian in type, hemiplegia, mental retardation, and ocular changes to be the outstanding symptoms. Thirty-four of their 81 collected cases were studied roentgenologically. X-rays of the skull revealed a characteristic shadow that had a double contour and in some cases seemed to follow the outline of the gyri and sulci of the cortex. In most of the cases, the shadows appeared to be in the region of the occipital lobe. Some showed atrophy of the brain and marked increase in vascularization.

HENRY K. TAYLOR, M.D.

Sialolithiasis in Infancy. T. Valledor, A. Codinach, and L. Expósito. Bol. Soc. cubana de pediat. **14:** 603–616, December 1942.

A case of sialolithiasis in a 10-year-old girl is reported. It is believed that the formation of the calculi began at the age of eighteen months. The right parotid gland, site of the calculi, was large and hard and had been so for about eight years, the condition having been diagnosed at various times as a parotid tumor. Roentgenograms revealed the calculi, which were removed through a buccal incision. They were thirteen in number, varying in size from bird shot to a large pea. They were composed of calcium carbonate and all those examined proved to be bacteriologically sterile.

Although relatively common in the adult, parotid calculi are rare in infancy.

A. MAYORAL, M.D.

Myeloma of the Maxilla with Bilateral Symmetrical Metastasis. Carlos E. Gárciga. Rev. med. cubana **53:** 794–800, September 1942.

A 6-year-old boy had a tumor of the jaw with bilateral metastases in the knees. The clinical as well as the radiological diagnosis was osteosarcoma, but because of the extreme sensitivity of the maxillary lesion to radiation the writer became suspicious and requested a biopsy. This revealed the tumor to be a myeloma.

A. MAYORAL, M.D.

Roentgenologic Examination of the Pharynx. Siegfried W. Westing. Am. J. Roentgenol. **49:** 587–592, May 1943.

Whenever the roentgenologist is performing an opaque meal examination of the alimentary tract, he has an opportunity to examine the lower half of the pharynx, but this opportunity is frequently neglected. The short duration of the filling of the normal pharnyx makes it difficult to obtain roentgenograms of that area, and this being the case, the role of roentgenoscopy becomes more important. One should make it a rule to return to this region after the study of the stomach is completed. In the postero-anterior projection the width of the pharynx is determined by the distance

between the lateral walls of the piriform sinuses. The chief characteristic of this view is the completely symmetrical appearance of the barium stream. Even slight asymmetries may be of diagnostic significance. After the bulk of the barium has left the pharynx, small residues normally remain for a short period in the valleculae and piriform sinuses. Lateral and oblique observations are also made.

Roentgenograms are reproduced showing the normal pharynx and abnormal filling due to the presence of carcinoma. One of the carcinoma patients did not have the characteristic history of dysphagia. As symptoms may be lacking in such conditions, it is especially important that this area be scrutinized carefully on roentgenoscopic examination with the barium meal. CLARENCE E. WEAVER, M.D.

THE CHEST

Discussion on the Place of Miniature Radiography in the Diagnosis of Diseases of the Chest. W. D. W. Brooks *et al.* Proc. Roy. Soc. Med. **36:** 155–160, February 1943.

This discussion was opened by Surgeon Captain W. D. W. Brooks, R.N.V.R., who stated that fluorographic examinations were introduced into the British Royal Navy in the spring of 1940, to include the entire service. Up to July 1942, 166,598 men were examined. Among these there were revealed 1,370 cases (8.2 per 1,000) of pulmonary tuberculosis of adult type: 498 minimal, 584 moderately advanced, and 288 far advanced. In addition there were found 27 cases of active primary tuberculosis, 3 of chronic miliary tuberculosis, 35 of pleurisy with effusion, 3 of tuberculous empyema, and 1 of spinal caries of tuberculous origin. Many other lesions affecting the thoracic cage and its contents were also discovered. During the third quarter of 1942 an additional 50,000 men were examined, and the incidence of tuberculosis in this group was slightly higher. Two cases of bronchial carcinoma were found in the 217,000 examinations.

The fluorographic examination is used only to detect the presence of disease. When it is demonstrated, the usual routine examinations and clinical studies are made for diagnosis. Experience has confirmed the wisdom of this practice.

Major J. Duncan White refers to the experience with fluorography in the British Army and mentions a survey by Major Kerley, covering some 5,000 men and showing results similar to those given by observers in the other services. He mentions the use of 4 × 5-in. films in the U. S. Army; compulsory periodic fluorographic examination of the chest for all persons over 15 years of age in Norway, under German domination; and the incidence of unsuspected tuberculosis (1.5 per cent) found in 2 million fluorographic examinations in Germany. He believes that mass chest surveys are a vital step in the direction of the earlier detection of pulmonary tuberculosis and agrees with Brooks that the method is not to be condemned because a few minimal lesions may be missed, and that the correct procedure in any case in which the fluorograph is suspicious is re-examination with a full-size roentgenogram. Rechecks will vary from 3 to 5 per cent. The greater the experience with fluorographs, the fewer rechecks will be required.

White quotes Crawford's observations in a group of 300 men discharged from the Army for pulmonary tuberculosis (Lancet **2:** 89, 1942). The lesions were described as minimal in 24 per cent, moderately advanced in 66 per cent, and advanced in 10 per cent. These men had been passed recently by recruiting men, but were not submitted to x-ray examination. At least three-fourths of the number would have been rejected for service had a fluorographic examination been available at the time of or soon after enlistment.

Wing Commander R. R. Trail concluded the discussion. He stated that for every 1,000 examined, 35 to 40 will require re-examination with large films, 20 will require clinical examination, 8 will show disease, and 3 will require hospitalization. A static unit could make between 75,000 and 100,000 examinations a year. He would like to see mass surveys on a national scale. HENRY K. TAYLOR, M.D.

Incidence of Pulmonary Tuberculosis of the Adult Type in the R.A.F: Results of Mass Radiography of 75,000 Cases. A. G. Evans. Brit. M. J. **1:** 565–566, May 8, 1943.

The author offers an analysis of age incidence of pulmonary tuberculosis of the adult type and discusses problems which will arise in the future when mass radiography becomes the natural undertaking. Statistics are presented which are based on mass examination of active cases, for the most part among airmen. Some of these showed unilateral tuberculosis while others had bilateral infections. Sets of figures are also presented based on mass examination of the W.A.A.F. organization.

The criterion of activity is a strict one. Every patient suspected of tuberculosis had a full-sized roentgenogram with complete clinical examination including blood sediment, sputum, and exercise tests. It is interesting to note that 28 per cent of the people one time considered "fit" had actually reached the stage of cavity formation at the time of examination, which fact presents an important bearing on radiographic examination. Approximately 2 "bad" cases for each thousand examined were discovered and the opinion is expressed that this percentage would be definitely higher in civilian groups.

Routines of observation are presented and it is suggested that in the young age groups a roentgenogram should be made twice yearly for the first two years and then annually for the following three years. The author seems to be of the opinion that mass radiography is of great importance in discovery of advanced cases, which are a serious source of spread of infection. Q. B. CORAY, M.D.

The Round Pulmonary Tuberculous Focus. I. D. Bobrowitz. Am. Rev. Tuberc. **47:** 472–483, May 1943.

This study of the round pulmonary tuberculous focus is based on a series of 55 patients. In 33 of these the focus was present when the patient was first seen, while in 7 others it appeared on subsequent examination, either in areas of previously normal lung or in areas where there had been infiltration. In 7 patients spontaneous closure of a pulmonary cavity resulted in a round focus and in 8 others round foci were formed by the closure of cavities as a result of pneumothorax. Of those patients with a round focus demonstrable at the original examination, the majority showed stability of the foci on subsequent examination.

Many ideas have been presented to explain this particular type of pulmonary infiltration. From the

study of the cases presented, the author is of the opinion that these foci are the end-result of tuberculous cavitation. He found nothing to suggest that they resulted from a primary infection, but all of the evidence seems to point to a relationship with previous cavitation. The round focus, however, represents only one form of cavity closure.

At necropsy, these foci have been shown to be spherical bodies of thick, caseo-calcified structureless material enclosed in a dense connective-tissue or hyalinized capsule of varied width. It is pointed out that, though this type of lesion is usually benign, it is capable of progression even after long periods of time and should be carefully followed. An increase in the size of the focus often precedes actual cavitation or progression and is an indication for collapse therapy, the type depending upon individual variation. Bed rest alone does not promise the immediate control of the lesion that is required. L. W. PAUL, M.D.

Chest Conditions Simulating Tuberculosis. E. R. Crow. Minnesota Med. **26:** 430–436, May 1943.

Crow's observations are based on cases with which he has come in contact in the course of his work in the Minnesota State Sanatorium.

Acute Pneumonia: Lobar pneumonia in children, when of the exudative type, may simulate the primary infection of tuberculosis. The time required for clearing is of value in the differential diagnosis. A case is cited in which tuberculosis was ruled out by clearing in a period of two weeks, in spite of a positive Mantoux reaction. In adults bronchopneumonia may cause confusion.

Silicosis: The principal diagnostic features in silicosis are enlargement and increased density of the hilar nodes, bilateral lower and mid-lung areas of linear density radiating from the hilus, and the presence of silicotic nodules. There are no shadows of annular type suggestive of the cavities seen in tuberculosis. Serial roentgenograms made over long periods of time show little change in the picture. It is to be borne in mind, however, that tuberculosis may complicate silicosis.

Pulmonary Abscess: Abscesses are usually unilateral, occurring in the lower or mid-lung field. Roentgenographically they appear as dense, circumscribed areas, thick-walled, and usually containing fluid. Bronchograms may be of aid in diagnosis. The evaluation of the Mantoux test here, as in other conditions, depends upon the age of the patient and other factors.

Bronchiectasis: In bronchiectasis the history is often that of long-continued cough and expectoration and recurring episodes of respiratory infection. Bronchography is usually diagnostic, though plain films often suggest bronchial dilatation. In a roentgenogram reproduced in this connection fan-like linear shadows are seen radiating from the hilus downward to the lower lobes. Films may show in addition such associated conditions as atelectasis, abscess, bronchial tumor, abnormalities of the cardiac shadow, and foreign bodies.

Carcinoma: In carcinoma pain and dyspnea are more prominent symptoms than in tuberculosis. The x-ray is of great value in differentiation. While both diseases show a predilection for the upper lobes, carcinoma usually spares the apices and originates in the hilus. Partial or complete atelectasis of an area without lesions suspicious of tuberculosis elsewhere in the lung is suggestive of carcinoma. Such areas are in fact usually the first x-ray evidence of tumor, being due to obstruction of the bronchus in this area. Sputum examination, bronchography, and bronchoscopy all are of importance diagnostically.

Other Conditions: Less difficulty is experienced in excluding chronic passive congestion, postoperative atelectasis, and the other conditions in which thickening of the linear lung markings or the production of infiltrative areas may occur. The author reports one case in which he feels that a diagnosis of syphilitic pulmonary involvement of diffuse type was justified. PERCY J. DELANO, M.D.

Imitation of Pulmonary Tuberculosis by Acute and Chronic Congestion in Cases of Mitral Stenosis. Albert Alder. Schweiz. med. Wchnschr. **73:** 530–532, May 1, 1943.

The author reports two cases of mitral stenosis in which hilar enlargement and increased perihilar markings simulated roentgenographically a recent tuberculous infiltrate. Both cases went on to pulmonary edema, roentgenologically confirmed, and in neither was tuberculosis ever proved.

The first patient had numbers of pulmonary calcifications, which the author ascribes to chronic stasis. However, a positive tuberculin reaction was obtained and no autopsy is reported (the patient being apparently still living when the article was written), so that this conclusion may be open to question. In the second patient the roentgenogram showed numerous fine nodulations similar in appearance to miliary tuberculosis. These also were believed to be solely the result of stasis. Such findings may lead to an erroneous diagnosis of hematogenous dissemination. LEWIS G. JACOBS, M.D.

Primary Friedländer Pneumonia. L. Hyde and B. Hyde. Am. J. M. Sc. **205:** 660–675, May 1943.

This report is based on 51 cases of Friedländer pneumonia. Acute and chronic cases are here considered together, since there were no significant differences in age, sex, or seasonal incidence, type of organism, lobes involved, or symptoms.

The thick capsules of the short, gram-negative, non-motile, non-sporing rods are easily stained. The mucoid, or smooth, colony is the type most important clinically. The soluble specific substances of *B. friedländer*, type B, and of *Pneumococcus* type II are closely related chemically and serologically, since serum of one will protect mice against infection by the other. The bacilli have been isolated from the respiratory tract, stools, urine, bile, meninges, vagina, and uterus.

Friedländer pneumonia is most likely to be found in males over forty. Over half the cases in the authors' series had their onset between November and April. Debilitating factors are important, but the disease usually develops suddenly in previously healthy persons. The reported incidence of this type of pneumonia is low, ranging from 0.5 to 5.0 per cent. The range of incidence in the normal upper respiratory tract varies with different reports from less than 1 to 5.8 per cent.

When death occurs in the acute phase, the lungs are large, heavy, firm, bright red in color, with thick, gelatinous, tenacious, reddish-gray alveolar exudate. The pleura over the involved lobes is covered with a heavy fibrinous exudate. In less than half the cases

many small (1 to 6 mm.) abscesses can be seen. Microscopically the alveoli are filled with a serous or cellular exudate. In more cellular areas there is usually a fibrinous meshwork. The alveolar septa are destroyed and there are areas of alveolar hemorrhage. The interlobar and interacinar septa are thickened and greatly enlarged.

The main process in the chronic phase is parenchymal destruction with abscess formation. One or more large cavities may be present. Empyema, pericarditis, meningitis, and not uncommonly fatty liver and portal cirrhosis may be found.

The onset, as with lobar pneumonia, is usually sudden, with cough, sputum, chest pain, and chills. The admission diagnosis is usually lobar pneumonia. The temperature elevation, pulse, and respiratory rates are not different from those of lobar pneumonia. About 30 per cent of the patients have a leukocyte count of 11,000 or below. The physical signs are also those of lobar pneumonia.

During the acute phase the predominant roentgenographic finding is a massive dense homogeneous shadow, frequently suggesting fluid. In about one-third of the cases (the group entering the chronic phase) there is a sequence of primary bronchopneumonia, secondary pseudolobar confluence, necrosis with formation of multiple thin-walled abscesses, and the stage of fibrosis and healing.

Bacteremia, when it occurs, is usually slight quantitatively, but the mortality rate among the bacteremic patients is higher than for those without bacteremia.

Acute primary Friedländer pneumonia may lead to early death (one-half of the cases), fairly prompt recovery with resolution (one-sixth of the cases), or necrosis and abscess formation (chronic phase, in one-third of the cases). Fifteen of the authors' series had lung abscesses clinically, while most of the patients showed lung destruction at autopsy. Meningitis and apical pneumothorax on the affected side occurred twice. Of 8 patients with pleural fluid, 3 had infected loculations. Three patients subsequently developed pulmonary tuberculosis. The adverse effects of suppurative disease on old and inactive tuberculosis has been emphasized by others.

The diagnosis of Friedländer pneumonia should be considered in all cases of pneumonia in adults where the etiology is uncertain. A Gram stain will reveal the organisms. An intraperitoneal injection of the patient's sputum into a mouse will cause death in twenty-four hours, with many characteristic bacilli in the peritoneal exudate and the heart blood.

The mortality rate in this series was 51 per cent. The rate varies with the number of lobes involved, and not with the age of the patient or the type of organism. Eighty per cent of the deaths occurred within five days of hospitalization.

The sulfonamides have some value when administered on the day of onset, but not thereafter. They probably have little value after suppuration occurs. Two patients had drainage of acute lung abscesses and did well. The chronic abscesses were treated conservatively, as most of the lesions will go on to fibrosis and healing. BENJAMIN COPLEMAN, M.D.

Importance of the Lateral Film in Pneumonias of the Middle Lobe. Rafael de la Portilla y Lavastida. Bol. de la Soc. cubana de pediat. **15:** 38–46, January 1943.

After setting forth rather extensively the reasons why a lateral chest plate should be made in the presence of pneumonia, the author presents two cases illustrating the points brought out in his discussion. He concludes that lateral chest roentgenography has demonstrated the greater frequency of pneumonia of the middle lobe, the fact that the roentgenographic image of pneumonias is always triangular, that the process always originates in the periphery, and that the most likely route of infection is the blood stream.

A. MAYORAL, M.D.

Angiocardiography. Harry M. Weber. Am. J. M. Sc. **205:** 747–753, May 1943.

This is a review of the work of Robb and Steinberg and others on the demonstration of the heart and large vessels with the aid of a contrast medium. It brings together in concise form the scattered articles on the subject and lists the references.

Calcification of Left Ventricular Infarction Recognized During Life. Milton C. Borman. Ann. Int. Med. **18:** 857–865, May 1943.

Calcified myocardial infarcts have been rarely found during life and and still more rarely proved at necropsy. This is the fourth case of its kind reported in the literature. It was first discovered by roentgen ray and was studied with heart tracings and the kymograph.

The patient was a white male, 74 years of age, complaining of cough and dyspnea. His blood pressure was 168/100. No murmurs were present. The electrocardiogram showed depressed RT wave in lead III, small Q in lead I, slurred R in leads I, II, and III. A chest roentgenogram revealed vascular pulmonary engorgement, cardiac enlargement to the left, and a dense ring-like area of calcification occupying the apex and lower third of the left border of the heart. This was believed to be a calcium deposit in an old infarct, subsequent to coronary occlusion, in the parietal wall of the left ventricle. Kymographic studies demonstrated an almost complete absence of ventricle pulsations, about midway between the base and apex.

Necropsy revealed a prominent bulging of the left ventricle, extending from the anterior to the posterior wall *via* the apex. When the ventricle was opened it was found that the area observed on its external aspect corresponded to the wall of an aneurysmal dilatation. Plaques of calcification were embedded in the wall between layers of scar tissue and remnants of myocardium.

The author calls attention to the fact that a diagnosis of cardiac aneurysm is seldom made, although according to Parkinson (Quart. J. Med. **7:** 455–478, 1938) aneurysm follows infarction in 9 per cent of cases. The present case would have escaped discovery without roentgen examination.

STEPHEN N. TAGER, M.D.

Enormous Aortic Aneurysm, Partly Dissecting, with Heart Wall Aneurysm. L. Bischoff. Schweiz. med. Wchnschr. **73:** 714–715, May 29, 1943.

A 67-year-old syphilitic had clinical and roentgen signs of aneurysm. The chest film (reproduced in the article) showed an aneurysm filling two-thirds of the upper half of the chest and a left ventricle with an almost hemispherical contour, indicating a probable aneurysm of the heart wall. The electrocardiogram

showed coronary damage of the posterior wall type. At the time of the report the patient was still alive.

LEWIS G. JACOBS, M.D.

Aneurysm of the Right Pulmonary Artery with Rupture into Bronchus and a Patent Ductus Arteriosus: Report of Case. Anton S. Yuskis. California & West. Med. **58:** 272–275, May 1943.

Aneurysms of the pulmonary artery are rare. Of 144 cases recorded in the literature, 31 were diagnosed ante mortem (including the present instance). The increasing number of correct diagnoses is due to improved roentgen methods.

The cases reported have been more or less evenly divided between males and females. Thirty per cent were in persons less than thirty years of age, and about half the patients had other malformations. Various causes have been assigned for pulmonary aneurysms, including increased pressure within the pulmonary circulation plus arteriosclerosis, syphilis, rheumatic fever, trauma, and congenital defects.

The most commonly observed clinical features are prominence of the left side of the chest, especially in the second and third interspaces, pulsation, systolic thrill, impaired resonance, and a harsh systolic murmur. Right cardiac enlargement may be observed, and electrocardiograms may reveal right axis deviation. Fluoroscopic and roentgenographic studies are of great importance. They show a prominence of the pulmonic arc on the left border of the cardiac silhouette, which pulsates synchronously with the aorta or "see-saws" with the left ventricle, tending to obliterate the "aortic window." Death is generally due to rupture of the aneurysm, congestive heart failure, or septic endocarditis.

The author reports a case of congenital aneurysm of the right branch of the pulmonary artery with rupture into the bronchus and a patent ductus arteriosus. An ante-mortem diagnosis was made by x-ray and confirmed at necropsy.

Chronic Empyema Due to Dermoid Tumors of the Mediastinum. John M. Dorsey. Surgery **13:** 755–761, May 1943.

The causes of chronicity in thoracic empyema have been listed as: inadequate drainage, presence of foreign bodies, communication with the lung, cavities that cannot be spontaneously obliterated, and tuberculosis or fungus infection. The author emphasizes a sixth cause—dermoid tumors of the mediastinum.

Dermoid tumors of the mediastinum are called epidermoids when derived from ectodermal elements, true dermoids when there is in addition evidence of mesodermal derivation, and teratoma when derivatives of all three germinal layers are present.

Secondary infection sometimes constitutes a deceiving as well as a dangerous complication of these neoplasms and may mask their presence behind the clinical syndrome of chronic empyema. Infection usually occurs from rupture into the neighboring pulmonary parenchyma or bronchi as a result of pressure. Suppurative pleurisy may result which, even when adequately drained, will not be permanently cured because of the underlying pathologic process. This fact is emphasized by two strikingly similar case histories.

The patients were young women—28 and 30 years of age—with a long history of thoracic symptoms. In each tube drainage had been instituted and a chronic sinus persisted. Subsequent surgical procedures revealed the presence of a dermoid tumor, which was successfully removed. Hair was present in each instance, and microscopic sections showed derivatives of ectoderm and mesoderm.

It is only by a carefully planned study that diagnosis of the underlying cause of chronic thoracic sinuses can be correctly made. Sputum and sinus discharges should be searched for tubercle bacilli, as well as for fungi. Roentgen examinations should be made in both the anteroposterior and lateral projections before and after the sinus is visualized by the injection of lipiodol. Diaphragmatic hernia must be ruled out. Bronchoscopy and endoscopic examination of the sinus may confirm a tentative diagnosis if hair, cholesterin, etc., are found.

Characteristically, dermoids are found in the anterior mediastinum, extending laterally and posteriorly as they enlarge. Because of the possibility of malignant change, early operative removal is advocated. The surgical approach in each patient must be individualized.

J. E. WHITELEATHER, M.D.

Intrathoracic Neuroblastoma: Case Report. Walter E. Lee and Joseph A. Ritter. Ann. Surg. **117:** 93–99, January 1943.

Neuroblastoma is the most common type of neurogenic tumor in infants and children. It can occur wherever sympathetic nervous tissue is present, but is most commonly found in the abdomen. The tumor may arise in the medulla of the adrenal or any of the ganglia extending from the cervical area to the pelvis. Roentgenologically, in thoracic neuroblastomas, a dense rounded shadow lying in the posterior portion of the chest is of diagnostic importance. The symptomatology is often negligible until pressure symptoms develop or metastasis occurs. In some reported cases there were manifestations similar to those found in adrenal chromaffinoma: tachycardia, profuse perspiration, vomiting, excitability, etc. These latter symptoms were present in the case reviewed by the author. In certain cases aspiration biopsy is indicated, and, in fact, may be beneficial, as neuroblastomas have been known to undergo spontaneous resolution after hemorrhage.

Once the diagnosis is established, even in the presence of metastases, surgery and irradiation are advisable. The experiences of Ladd and Gross and of Wyatt and Farber have definitely shown that the prognosis is not hopeless even though only a part of the primary tumor is removed.

A case is reported by the authors in an infant of five months. The symptoms and signs were very puzzling and the correct diagnosis was made only after aspiration biopsy under fluoroscopic guidance. The autopsy findings are presented.

P. C. BRIEDE, M.D.

Extraordinary Calcification in the Breast. Benjamin W. Anthony and Herbert C. Pollack. Am. J. Roentgenol. **49:** 600–602, May 1943.

The authors present a case of extensive calcification of almost the entire right breast in a colored female aged sixty-six. The history suggested that these changes were the result of trauma and hematoma formation occurring seventeen years previously. Calcification may occur in the breast in association with ade-

noma, cyst, hematoma, mammary tuberculosis, psammocarcinoma, necrotic areas of mammary carcinoma, calcinosis universalis, and osteitis deformans. It is much more common in benign than in malignant lesions.

Oblique and lateral roentgenograms are reproduced showing the radiating trabecular arrangement of the calcifications and associated ossifications in the authors' case. CLARENCE E. WEAVER, M.D.

THE DIGESTIVE TRACT

Roentgenology of the Digestive Tract in the Tuberculous. John L. Kantor. Am. Rev. Tuberc. **47:** 484–492, May 1943.

The author reviews the roentgen findings of tuberculosis of the various portions of the digestive tract. In the esophagus intrinsic tuberculous lesions are rare, and this is true of the stomach as well. In autopsies on patients dying of tuberculosis at Montefiore Hospital in the last 25 years, there were only two cases of gastric tuberculosis.

The study of tuberculosis in the small intestine offers an interesting and promising field to the roentgenologist. When the lacteal drainage of the small intestine is damaged by tuberculous disease of the mesenteric lymphatics so that fat absorption is impaired, steatorrhea may result. The condition is comparable to that occurring in sprue, and x-ray study may reveal a smoothing out of the valvulae conniventes in the jejunum and occasionally in the duodenum as well, to which the name "moulage sign" has been given. The roentgenological technic requires the frequent observation of the passage of a standard opaque meal through the entire small intestine, covering usually a period from three to nine hours after ingestion.

Tuberculous ulcers of the intestines are located chiefly in the ileocecal region. The roentgen diagnosis of tuberculous enterocolitis in the ileocecal region has not been highly accurate. In a series of 67 cases observed at Montefiore Hospital, in which the roentgenologic findings were controlled at necropsy, it was found that in only 32 instances, or 48 per cent, results of both methods coincided precisely. One of the reasons for this discrepancy is the fact that individual ulcers in the lower intestine cannot be demonstrated roentgenologically and the diagnosis, therefore, is presumptive, usually based on indirect signs such as increased irritability or spasm. To be significant, the area of filling defect due to irritability or spasm should involve the cecal colon, since this is the region where tuberculous ulceration is most likely to exist. Secondly the irritability must be shown to be constant or at least repeated.

The direct diagnosis of intestinal tuberculosis is based on the demonstration of roentgen abnormality caused by the lesions themselves. Such appearances are rare. The distinctive characteristics of tuberculosis are that the cecal colon is always irritable and in cases of tuberculoma the deformity is of a fixed and constant pattern. In differential diagnosis regional ileitis can usually be distinguished by the fixed deformity in contour of the terminal ileum, a dilatation of iliac loops proximal to the deformity, and the presence of a "string sign," which has not been observed in intestinal tuberculosis. L. W. PAUL, M.D.

Peptic Ulcer in Childhood. Albert B. Newman. Am. J. Dis. Child. **64:** 649–654, October, 1942.

The importance of the consideration of peptic ulcer and roentgen examination in cases of obscure abdominal pain in children is discussed. Over 50 cases have been reported in the literature. The author reviews the etiological possibilities with the conclusion that the cause of the disease in the child, as in the adult, remains obscure.

That peptic ulcer in childhood is rare is brought out by many reports. Perry and Shaw, for example, found 70 cases in 17,650 autopsies. Distribution between the sexes is about equal in contrast to male preponderance in adults.

Six cases are reported which bring out the similarity to the adult disease in the prepuberal age group. In the younger children, night pain or pre-breakfast pain was uncommon and tenderness was usually periumbilical rather than epigastric.

The diagnosis of peptic ulcer in children is basically roentgenologic, the roentgen changes being the same as in adults. The chief complications are hemorrhage and pyloric obstruction. In general, the outlook for healing is excellent. The routine alkaline therapy is used. Subtotal gastrectomy may be resorted to in cases of chronicity or recurring hemorrhage, but is seldom necessary. GEORGE M. WYATT, CAPT., M.C.

Cancer of the Stomach: with Special Reference to Early Diagnosis. I. W. Held and Irving Busch. Ann. Int. Med. **18:** 719–735, May 1943.

Carcinomas of the stomach may be divided into two main groups: (1) those arising on a healthy gastric mucosa and (2) those originating in a previously diseased mucosa.

(1) Of the first group, which comprises about 70 per cent of the total, certain types are slow-growing and metastasize late, and to these the authors devote considerable space, describing the symptomatology and roentgen findings in some detail. *Cancer of the pars media*, involving both the anterior and posterior walls, produces the typical hour-glass picture. The edges of the constricted portion are irregular, and the canal between the upper and lower parts of the hour-glass is centrally situated in contrast to the canal of hour-glass due to ulcer, which is on a line with the lesser curvature. Also, in cancer the upper sac fills only partially with barium and therefore is smaller than the lower sac. The rapid passage of food into the duodenum is an important finding in *pyloric cancer*. The pylorus appears as a rigid tube, peristaltic waves may be diminished or absent in the pyloric region, and there is a conspicuous absence of antral contraction. Occasionally cancer is limited to the *posterior wall and lesser curvature* of the stomach. In most of these cases the lesion is a slowly growing scirrhous type and the roentgen studies reveal a rigid pars media, absence of peristalsis, and sometimes actual deformity of the pars media. *Cancer of the cardia* may be extremely difficult to detect roentgenologically. Films should be taken in every possible position and every effort should be made to demonstrate the air bubble, as its deformity is an important sign of cancer in this region. The authors conclude the discussion of these slow-growing cancers with a description of *scirrhous carcinoma* involving the entire stomach. The stomach appears as a narrow rigid tube transversely placed well above the umbilicus. Fluoroscopically the barium

is seen to pass through so rapidly that within less than an hour the entire stomach is empty. The air bubble is small or wholly absent. Often the barium is regurgitated into the esophagus, and the stomach and esophagus appear as two tubes, one vertical and one transverse.

These slow-growing cancers, the authors believe, should be subjected to surgery even though a large palpable mass is present, for though the immediate mortality is as high as 10 or 15 per cent, lasting and good results may be expected if the operation is successful.

The medullary type of gastric cancer also arises, as a rule, on previously healthy mucosa, but grows rapidly and metastasizes early, mainly to the neighboring lymph nodes and liver. Roentgen examination shows an eaten-out pars media extending to the pylorus. Operation in these cases is attended by a high mortality but may produce worthwhile palliation if the patient survives. The small group of cancers metastasizing by way of the blood stream are not amenable to surgery.

(2) The second large group of cancers, those arising in previously diseased mucosa, tend to develop more slowly and to be more benign in character and therefore offer a better prognosis. The precancerous symptoms vary in nature, are usually bizarre, non-characteristic, and generally interpreted as neurogenic. Three separate groups of clinical entities are listed, on the soil of which cancer may develop.

(*a*) *Gastritis:* The gastroscope may establish the presence of early cancer before a roentgen diagnosis is possible, thus enabling prompt surgical intervention, with a possible permanent cure. Roentgen evidence of stiffening of the pars media and pylorus or very active or complete absence of peristalsis in this region justifies surgical exploration. A narrowed pylorus in conjunction with anacidity is particularly suspicious of cancer.

(*b*) *Polyps:* Congenital polyps may be single or multiple, and pedunculated. They are less important from the standpoint of cancer development than the acquired type, which originates on a basis of gastritis. Gastroscopy and biopsy are the conclusive diagnostic methods.

(*c*) *Gastric Ulcer:* Whether cancer can develop subsequent to an ulcer is a moot question. The authors believe that an ulcer may actually precede the development of a cancer. Furthermore, a cancer can begin with ulcer symptoms, even without the presence of an ulcer.

As to the criteria in determining whether an ulcer has become cancerous, the authors discuss at length the significance of the niche, quoting various authorities and citing illustrative cases. They conclude that the chief emphasis should be placed on the persistence and aggravation of symptoms. Patients with ulcer symptoms, without ulcer signs, should be observed with greater suspicion and more watchfulness for early cancer than those in whom ulcer is clinically and roentgenologically demonstrable.

STEPHEN N. TAGER, M.D.

Diverticula and Variations of the Duodenum. Wolfgang Ackermann. Ann. Surg. **117:** 403–413, March 1943.

Plaster of Paris casts of the duodenums of 50 cadavers were made and injected with methylene blue to determine the relation of the ampulla of Vater to the duodenum. The cadavers were selected at random.

Illustrations of eleven specimens with a total of fourteen diverticula are included. Twenty-two per cent of the series had duodenal diverticula, the highest incidence so far recorded. The distribution was as follows: none in the first part of the duodenum, five in the second part, one between the second and third part, five in the third part, and three in the fourth part. All were on the concave or pancreatic border and the majority were globular in shape.

The author quotes Maclean, Scott, McKinney, Costello and other authors regarding the roentgenographic diagnostic procedures and limitations. He concludes that, in spite of numerous technical difficulties, these anomalies are quite frequently discovered roentgenologically. A perfect technic and a genuine interest on the part of the roentgenologist in the particular subject are, however, essential.

Incidentally it was observed that the papilla is not constant in its location, occurring at the lower bend of the descending portion of the duodenum, at the medial side, and at the posteromedial side. It was also found that the duodenum is not infrequently made up of three parts instead of the classical four and that it may vary as to configuration and size.

A bibliography of more than 100 references is appended. H. L. VAN HALTERN, M.D.

A Case Successfully Treated by Duodenoduodenostomy. Atresia of the Duodenum. Charles S. Ward, Jr., and Frederick W. Cooper, Jr. Ann. Surg. **117:** 718–722, May 1943.

The authors present a case of atresia of the second portion of the duodenum successfully treated by duodenoduodenostomy at the age of five days. This is the only case recorded treated in this manner and the fifteenth in which a patient with complete duodenal atresia survived. The 14 previously reported cases, in which various anastomosing procedures were employed, are tabulated, the sites of obstruction and types of anastomosis being listed.

The authors stress the location of atresia in relation to the ampulla of Vater as a determining factor as to the type of surgical procedure to be used. They also emphasize the importance of preoperative and postoperative care.

Reproductions of roentgenograms illustrate the article. H. L. VAN HALTERN, M.D.

Chronic Partial Intestinal Obstruction Due to Intussusception of an Appendix Epiploica. Maurice S. Harte. Surgery **13:** 555–559, April 1943.

The unusual pathologic course of events in the clinical history prompted the report of the following case.

A white man 56 years old had for twelve weeks observed a change in his regular bowel habits. He gave a history of mild left lower quadrant abdominal discomfort, constipation, a dry, thin stool, slightly blood-streaked at times, and a free passage of flatus but no nausea or vomiting. A loop of distended bowel was visible in the left lower quadrant but there was no mass, tenderness, or rigidity. The intestinal mucosa appeared normal on sigmoidoscopy. Roentgen studies, repeated on three occasions, revealed complete obstruction at the mid sigmoid, with a filling defect at that point, which was believed to represent typical carcinoma. At operation a puckering of the pos-

teromedial wall of the sigmoid was observed with what at first was thought to be a submucous lipoma about 3 cm. in diameter almost completely obstructing the lumen of the bowel. The proximal colon was dilated; the distal colon was normal. There were no palpable lymph nodes and the liver was normal. Closer inspection proved the lesion to be an invagination or, better, an intussusception of an epiploic appendage into the bowel, causing an almost complete obstruction. Palpation through the wall of the bowel indicated the mucosa was ulcerated. Since there was no proof that the mucosal lesion was benign, it was decided to excise the segment of bowel.

In the center of the resected portion of the sigmoid was a puckered mass which had carried along with it an epiploic appendage. The part which had become invaginated consisted of a partially necrotic mass which was roughly spherical in shape and measured 3.5 cm. in diameter. The mucosal surface was greenish and necrotic at the head of the mass but at the base was granular and moderately inflamed. The mass was found on microscopic study to consist of fat tissue. Its surface was covered by a thinned-out muscular layer of intestinal wall.

Several theories are suggested to account for the unusual invagination observed in this case. A plausible one is that a submucous lipoma or polyp may originally have been present, attached to the bowel wall at the site of the ulcerated mucosa covering the invaginated portion. The dragging action of the fecal stream upon this growth gradually increased its length and narrowed the neck of the pedicle, at the same time tending to invaginate the wall at its base. This could weaken the muscle layer of the wall at the area subjacent to the base of an epiploic appendage and thus invaginate the appendage. Continued pull of the fecal stream could pull off the polypoid growth, leaving an ulcerated mucosal base which persisted.

The author was able to find no similar report in the literature until after the acceptance of his case for publication, when 3 examples of intestinal obstruction caused by epiploic appendages were published by Giffin, Manamy, and Waugh (Arch. Surg. **45:** 351–360, 1942). J. E. WHITELEATHER, M.D.

Microscopic Diagnosis of Radiopaque Substance in the Vermiform Appendix. S. Sanes and John Ambrusko. Surgery **13:** 561–568, April 1943.

In 1937, the curiosity of the authors was aroused by a peculiar content, observed microscopically, in the lumen of an appendix which had been sectioned following removal at operation. The content was interpreted as radiopaque substance received by the patient at some time for roentgen examination. This interpretation was subsequently confirmed.

From Oct. 1, 1940, to Sept. 30, 1941, 10 cases were found at the Buffalo General Hospital which showed microscopically what appeared to be barium sulfate in the appendix. All these patients had had a gastro-enteric study or barium enema within eight days before operation. From Oct. 1, 1940, to Sept. 30, 1941, at the Buffalo Children's Hospital 4 specimens were obtained which contained what appeared to be barium sulfate, the longest interval between gastro-enteric study with barium and operation in this group being five days. From September 1939 to October 1940, 3 specimens were obtained at the Niagara Falls Memorial Hospital which appeared to contain barium sulfate. In one of these cases a gastro-intestinal series had been made 44 days before operation; in the others the interval was two, six, and four days, respectively. These 17 specimens were found among 1,395 appendices examined at the three hospitals.

Various means were employed to check the microscopic observations. Roentgen studies disclosed that, if present in sufficient amount, radiopaque substance may be demonstrated in the lumen of the appendix by x-ray films of slides made for histologic examination. In the gross specimen the substance appeared as a white opaque substance. With strong central illumination, barium sulfate appeared in sections on the microscope as glistening, green-gray, refractile, more or less amorphous material. It also appears as a glistening substance on darkfield illumination.

The interpretation of certain signs in radiographic study of the appendix has elicited considerable difference of opinion. One view holds that the normal appendix should generally be visualized during a gastro-intestinal examination and that absent or incomplete filling by radiopaque substance is evidence of disease. On the other side, it is maintained that the "normal appendix is visualized only by the opportune coincidence of its filled condition to roentgenographic fluoroscopic examination. Nonvisualization never necessarily means an occluded and nonfillable appendix." In this study the presence of barium sulfate was shown in the lumen of one appendix which had not been visualized in routine radiographic examinations on three occasions.

The microscopic diagnosis of barium sulfate along with the roentgenograms of the extirpated and embedded appendix appears to offer a new and simple method, at least in one group of cases, to check the frequency with which barium sulfate enters the lumen without detection by the roentgenologist.

In this group of cases barium sulfate was shown to have been retained in the appendix from two to forty-three days after ingestion or enema. Two questions arise. Is retention a direct histopathological finding indicative of disturbance in evacuation of the appendix? How far can it be correlated with the radiographic picture of "chronic appendicitis?"

In only one of 13 patients did the appendix show evidence of active inflammation, the remainder showed fecaliths, retrocecal position and adhesions, or "nothing remarkable." Since 3 of the cases were adjudged "not remarkable" within the scope of pathological criteria, this finding might be used to support the idea that "mere prolonged isolated filling of the appendix after the rest of the colon is free of barium cannot in itself be considered as evidence of pathological condition." Yet this may actually signify a disturbance of evacuation due to impairment of motility or to augmentation of normal physiological obstruction rather than to obvious mechanical obstruction. J. E. WHITELEATHER, M.D.

Right Diaphragmatic Hernia of the Colon Through the Hiatus of Morgagni, in a One-Year-Old Mongolian Idiot. Teodosio Valledor and Domingo Gómez Tejera. Bol. de la Soc. cubana de pediat. **15:** 51–69, February 1943.

The authors believe the type of hernia described here to be rather rare, as only a few such cases have been reported. They think that the condition had its

incipiency following a cold accompanied by severe cough and seizures of asphyxia, when the child was ten months old.

The hernia was diagnosed roentgenologically, and excellent roentgenograms accompany the report.

A. MAYORAL, M.D.

Blast Injury to the Abdomen by Depth Charge. D. Denham Pinnock and Paul Wood. Brit. M. J. **1:** 537–538, May 1, 1943.

The authors present an account of 5 cases of abdominal injury incidental to blast, which is quite timely since little information has thus far been published on this subject, attention having been given mostly to hemorrhagic lesions of the lung in this connection.

The patient's description of his symptoms suggests a violent blow to the stomach. Most victims felt as though they had been kicked. Those swimming from an abandoned boat in the vicinity of a depth charge suffered violent cramps but were generally able to swim to help. Death resulted in 4 out of the 5 cases. The chief pathological findings were perforations of both colon and small intestines.

Q. B. CORAY, M.D.

THE SKELETAL SYSTEM

Post-Traumatic Necrosis of Bone. Raymond W. Lewis. Am. J. Roentgenol. **49:** 593–599, May 1943.

Posttraumatica septic bone necrosis is encountered rather frequently in an active bone and joint service. Its most usual occurrence is following fractures and dislocations. It is seen occasionally, however, after less serious injury. It may occur as a result of repeated small traumata such as those incurred in ballet dancing. The most frequent site appears to be the upper extremity of the femur, with the carpal bones, tarsal bones and ankle, and elbow following in the order of frequency. In many instances changes are evident on the roentgenograms within a few months of the injury.

The author quotes Phemister (Arch. Surg. **41:** 436–472, 1940) in his description of the pathological processes following aseptic interruption of circulation in bone. From the surrounding living bone and joint structures there is fibrous invasion, with metaplasia and replacement of the dead bone by new bone. This is called "creeping substitution." When the cause of necrosis is a fracture followed by non-union, resulting in a considerable degree of disuse, there is enough atrophy of the adjacent living bone in one or two months to cause it to cast, in roentgenograms, a shadow fainter than that cast by the dead bone, which retains its original density.

During the period of bone necrosis and creeping replacement, the strength of the bone is greatly diminished and it cannot perform full function without danger of collapse, without danger of destruction of the anemic overlying articular cartilage. A permanently damaged joint then seems inevitable. Hence the importance of recognizing the existence of deficient blood supply and taking measures to protect the injured part.

Nine roentgenograms with appended case histories illustrate the circulatory disturbances described, while another shows a similar picture produced by Gaucher's disease.

CLARENCE E. WEAVER, M.D.

Osteochondritis Dissecans: A Discussion of Two Similar Lesions. C. W. Dawson. Arch. Surg. **46:** 635–638, May 1943.

Osteochondritis dissecans is an aseptic necrosis of subchrondral bone and the overlying cartilage, most frequent in young men, and incited by trauma. A somewhat similar condition, also called by some osteochondritis dissecans, is seen in older persons. It usually follows operation or trauma and consists in erosion or fibrillation of cartilage with eburnation of the subchondral bone. In no instance has the author seen this condition associated with osteochondromatosis. Diagnosis is dependent on a careful roentgen examination, since the clinical symptoms are not characteristic.

As the underlying factor in both lesions seems to be an aseptic necrosis with involvement of the cartilage and subchondral bone, they are both properly designated osteochondritis dissecans, but the second type might properly be called degenerative osteochondritis dissecans. The treatment of the two types is identical, consisting of surgical smoothing of the articular surface, with removal of loose fragments and overhanging shelves. Three cases are briefly reported to illustrate these points. Illustrations are included.

LEWIS G. JACOBS, M.D.

Critical Analysis of the Roentgen Signs of Infantile Scurvy. Ralph S. Bromer. Am. J. Roentgenol. **49:** 575–579, May 1943.

In 1928 the author attempted to enumerate the roentgen signs of infantile scurvy and to arrange them in sequence so that four stages would show the progress of the disease as demonstrated in the roentgenogram (Am. J. Roentgenol. **19:** 112–125, 1928. Abst. in Radiology **13:** 184, 1929). In the early stages he described the ground-glass appearance of the shafts, the dense zone of temporary calcification at the end of the diaphysis, and the "pencil-point atrophy" of the cortex. This was followed by the appearance of a zone of decreased density behind the zone of temporary calcification. Later, well developed subperiosteal hemorrhages were shown, and so-called epiphyseal separations occurred. In the final stage the repair of scorbutic lesions with absorption of the subperiosteal hemorrhages was described.

More recent literature on infantile scurvy and experience with the disease are discussed, and the question is raised whether the earlier classification into stages is warranted. It is known that none of the signs is pathognomonic except the subperiosteal hemorrhages. Park and his associates (Arch. Dis. Childhood **10:** 265–294, 1935) described a slight rarefaction and indentation at the distal border of the diaphyses of the radius, ulna, and tibia, and in the upper end of the humerus, which they called the "corner sign." The distal end of the femur showed this sign when the scorbutic process was well advanced. They conclude that there are no early roentgen signs of scurvy.

The author feels, however, that even if the ground-glass appearance and thinning of the cortex are not early signs, they nevertheless are useful in making a diagnosis of scorbutic atrophy previous to the roentgen recognition of subperiosteal hemorrhages and even before the clinical diagnosis is possible.

CLARENCE E. WEAVER, M.D.

Concomitance of Chronic Acidosis with Late Rickets. Julian D. Boyd and Genevieve Stearns. Am. J. Dis. Children **64:** 594–607, October 1942.

A very complete case report is given of a girl aged 11 1/2 years with late rickets and chronic acidosis. She had had progressive weakness, difficulty in walking, and leg deformities for four years. Roentgenograms showed advanced active rickets. The calcium content of the serum was normal, but the inorganic phosphorus was 3.1 mg. per 100 c.c. and the phosphatase 71.5 Jenner-Kay units per 100 c.c. The chloride content and alkali reserve were each about half normal. These findings indicated serious disturbance in electrolyte metabolism. Dysfunction of the renal tubules was considered causative or contributory to the condition.

Upon a prescribed diet, vitamin D, and sodium bicarbonate, the patient was observed in the outpatient department for a period of three years. Roentgenograms showed complete healing of the rickets. The alkali reserve and phosphatase level became normal and the urine was free from albumin. Polyuria, fixed low specific gravity, and neutrality of urine, however, persisted. Improvement continued until the last period of hospitalization, at which time the child had 2 attacks of weakness and paresthesia, the last one terminating in death.

At necropsy no immediate cause of death could be found. The kidneys were essentially normal. The fundamental disturbance was thought to be extrarenal.

Regardless of the fundamental cause, the case illustrates the following sequence: (1) chronic acidosis causing (2) increased elimination of fixed base, resulting in (3) depletion of calcium reserves in the form of rickets; (4) prolonged response to simple replacement therapy consisting of oral administration of sodium bicarbonate. GEORGE M. WYATT, CAPT., M.C.

Arthrogryposis Multiplex Congenita. Miriam Katzeff. Arch. Surg. **46:** 673–677, May 1943.

"Arthrogryposis multiplex congenita" is a term used to designate congenital contractures of the joints. First described in 1841 by Otto, it has also been called amyoplasia congenita and myodystrophia foetalis deformans. In seventeen years, this diagnosis was made in 18 patients admitted to the Children's Hospital in Boston. The ages of the children ranged from 5 days to 10 years and 7 months. In only one case was there a familial history. Various joints were involved, usually in the extremities; in 4 cases the spine was affected. Dislocation sometimes accompanied the contracture.

On physical examination, the affected extremities have a "stuffed sausage" appearance. Little muscle is palpable. Periarticular structures feel thickened and contracted. Dimples are frequently present over the patellas and elbows. Some passive correction of the contracture is usually possible. Deformities are symmetrical. Histologically there are atrophy and fatty replacement of the involved muscles. In the first few months of life roentgenograms show only deficient muscle shadows and increased density of the capsular areas; later secondary bony deformities appear.

Younger patients are usually treated by manipulation, with or without supports or surgical correction. Older patients require surgical correction of the deformity. Improvement is obtained in cases treated early. One case is reported in detail, with illustrations. LEWIS G. JACOBS, M.D.

Paratrooper Fracture. William J. Tobin. Arch. Surg. **46:** 780–783, May 1943.

Certain fractures are associated with a specific form of injury. A new type is here reported, which has been observed in a substantial proportion of the fractures sustained by paratroopers at Fort Benning, Ga., in the last two years. It consists of fracture of the posterior articular margin (posterior lip) of the tibia, with or without associated fracture of the external malleolus and/or the internal malleolus. This fracture is comparatively rare in civilian life. It has not usually been severe. Open reduction was not required in any case seen by the author. Protection was probably afforded by the high boots worn by the jumpers. Treatment consists in immediate immobilization in plaster. In simple fracture of the posterior lip, the soldier was allowed to resume jumping on recovery—seldom under three months. Soldiers sustaining trimalleolar fractures were placed on a "permanent non-jump status." LEWIS G. JACOBS, M.D.

Low Back Pain, Anatomic and Constitutional Aspects in Differential Diagnosis. Harry E. Mock. Wisconsin, M. J. **42:** 389–400, April 1943.

Prior to the days of specialization and roentgenology, "guess work" was the chief diagnostic method in low back pain. Today, criticism is directed to the manner in which low back pain, in patients with a traumatic history, no matter how trivial, is diagnosed as a nucleus pulposus derangement, or herniated disk, or thickened ligamenta flava. The author admits that a herniated disk may account for low back pain, but takes issue with the manner in which some neurosurgeons make the diagnosis. He is averse to the diagnosis of a disk lesion and the recommendation of surgery on a hurried physical examination, absence of roentgen studies, the presence of the so-called pathognomonic "sneeze-pain reflex," and omission of conservative treatment. Surgery should be limited to those who fail to respond to conservative measures; otherwise the procedure may ultimately fall by the wayside.

There are many causes for low back pain. Some of them are: (1) herniated disk; (2) faulty posture; (3) flat back; (4) gynecological disturbances, as uterine displacements or salpingitis; (5) urological disturbances, as floating kidney; (6) gastro-intestinal disturbances, as ptosis; (7) psychogenic factors; (8) sprain; (9) muscle spasm and imbalance of muscles; (10) use of appliances over long periods of time, prolonging disability; (11) lesions in the smaller articulations; (12) contraction of intramuscular fascia and aponeurosis covering the back muscles; (13) obesity; (14) change from an active to a sedentary life; (15) myositis; (16) spondylolisthesis, and other conditions.

Conservative treatment is recommended—bed rest on a hard flat mattress or a fracture board, sedatives, proper and adequate physical therapy, such as heat, massage, and corrective exercises. Hyperextension apparatus is recommended for flat back. If this treatment is unsuccessful, when repeated examinations fail to reveal other causes, when the psychogenic element has been eliminated, and if neurologic symptoms persist or increase, one is justified in making a diagnosis of a ruptured intervertebral disk and operating.

During the past three years 300 cases were examined. Approximately 200 were under treatment. Most of these were allegedly traumatic. The diagnosis of a disk lesion was made in only 2 patients. One refused operation, and in the second no herniated disk was found. The latter patient proved to be a malingerer, and recovery followed a financial settlement. Almost all of the patients recovered and returned to work within four to six weeks, while a few required months of treatment. The majority of the patients were of the Stiller (psychogenic) type. Metastatic cancer was found in 2, Pott's disease in 2, gallstones in one, a penetrating ulcer in one, and a chronic retrocecal appendix in one. HENRY K. TAYLOR, M.D.

Congenital Narrowing of the Lumbosacral Space. Theodore H. Vinke and Edgar H. White. Surg., Gynec. & Obst. **76:** 551–555, May 1943.

The authors believe that congenital narrowing of the lumbosacral disk occurs often enough to warrant its consideration as an asymptomatic finding, without associating such narrowing indiscriminately with herniated disk. In a review of films of 300 children from 5 to 15 years of age, there were found 3 cases of narrowing aside from those caused by specific disease. In all 3 cases associated anomalies (lumbarization or sacralization) were present. Williams, Willis, and Hodges and Peck are quoted in support of the belief that these anomalies are commonly associated with a narrow lumbosacral or first sacral space.

The authors report 6 cases of low back pain in adults, 3 presenting radiation of pain. All were improved or cured by conservative management, although all films revealed narrowing of a disk and anomalies of the 5th lumbar and/or 1st sacral segments. These writers are concerned over the widespread tendency to interpret diminished disk spaces with anomalies as evidence for ruptured disk.

Excellent roentgen illustrations are included.

EDWIN L. LAME, M.D.

New Aspects of Spinal Injuries. Arthur G. Davis. Arch. Surg. **46:** 619–634, May 1943.

Although considerable misapprehension existed in the past about the treatment of spinal fractures, there are a number of points about which general agreement has now been reached:

(1) Hyperextension is generally applied in the reduction of spinal fractures.

(2) The vertebral centrum will form callus as promptly as other bones.

(3) In cases of paralysis, laminectomy occupies a place distinctly secondary to that of hyperextension.

(4) The Queckenstedt test is invaluable in determining subarachnoid block.

(5) Skeletal traction is a useful adjunct in cervical injuries.

(6) Since the posterior vertebral arches are capable of supporting the weight of the torso alone, the latter part of convalescence may be ambulatory.

(7) The anterior longitudinal ligament is the main "check-strap" opposed to excessive hyperextension.

Among the points of disagreement the first to be mentioned is the length of convalescence. All variants from immediate walking after reduction and application of a plaster jacket to six months in bed are practised. Since fissure fractures of the posterior arch are frequent and cannot always be shown in radiographs, the first course seems unwise. Six weeks of recumbency is safe and leads to good results. The method of reduction of compression fractures is another source of disagreement; the author believes that foot suspension is simplest and satisfactory.

Diagnosis of posterior arch fractures by inference is necessary, since the roentgenogram cannot be depended on to show even gross fractures of the pedicles, articular processes, and laminae. Some films made on denuded spines cut with a Gigli saw are reproduced to demonstrate this difficulty. Oblique views are most apt to show such lesions. A false sense of security sometimes results from the normal appearance of these parts on a roentgenogram. A careful analysis of the alignment of the various parts will help protect the operator against this error of interpretation.

Experimental studies of the tensile strength of the anterior longitudinal ligament showed an average breaking point of 337 pounds. The maximum pull required in any case for reduction of a fracture was 80 pounds. This four-to-one factor of safety seems ample except in cases of hyperextension injury or of fracture dislocation.

Cervical luxation, caused by injuries such as an automobile whip lash, leads to painful conditions but often produces no definite roentgen sign. There may be a minimal forward displacement, a sixteenth of an inch or more; more significant is the abolition of the normal curvature in the lateral projection, usually with a slight suggestion of anterior angulation at one intervertebral space. The diagnosis often cannot be strictly proved, but splinting in hyperextension immediately is imperative to prevent root pains and traumatic arthritis. A collar should be worn for several weeks to several months. If one waits until obvious dislocation has occurred (the normal movements of the neck will eventually produce this, because of the rupture of the posterior ligaments), an extensive fusion will be needed to relieve the pain.

[While meticulous technic should lead to the diagnosis of a greater number of the posterior arch fractures than the author appears to consider possible, the unfavorable conditions under which many, if not most, roentgenograms of spinal fractures must be obtained make such technic impossible and lend point to his comments.—L. G. J.] LEWIS G. JACOBS, M.D.

Dislocation of the Knee: Report of Four Cases. Randolph L. Anderson. Arch. Surg. **46:** 598–603, May 1943.

Complete dislocation of the knee is relatively rare. There are five types: anterior, posterior, medial, lateral, and rotatory, named according to the direction of tibial displacement. There is always considerable tearing of the lateral and cruciate ligaments. The popliteal vessels are occasionally torn, with resultant gangrene necessitating amputation. Nerve injuries have been reported, and concomitant fracture is frequent.

Treatment is by gentle reduction under anesthesia, followed by immobilization in plaster. The duration of immobilization has not been well standardized among the various writers on the subject. Open reduction is occasionally necessary. Operative repair of the ligaments is seldom needed, and should be deferred until conservative measures have been given an adequate trial.

Four cases are recorded to illustrate these points. In one case closed reduction was not found possible, and open reduction was employed successfully. In another case amputation was necessary for gangrene.

LEWIS G. JACOBS, M.D.

Notes on an Early Bone Cyst. C. B. Bennett. Arch. Surg. **46:** 608–610, May 1943.

A boy was first seen in May 1938, at the age of 9 1/2 years. A routine study of development included roentgenograms of the left knee, which appeared normal. On Nov. 3, 1939, another study showed a tiny bone defect in the tibia. By May 1940 this had enlarged to 3 × 3 mm. and by May 1941 a further considerable increase in size had occurred. On Aug. 15, 1941, the cyst was curetted and swabbed with 50 per cent zinc chloride. Films made Nov. 4, 1941, showed satisfactory healing. A pathologist diagnosed the scrapings as giant-cell tumor of bone.

LEWIS G. JACOBS, M.D.

Chloroleukemia (Clinical Case). Rafael de la Portilla y Lavastida. Bol. de la Soc. cubana de pediat. **15:** 121–135, March 1943.

A case of acute hemocytoblastic leukemia of one month's duration when first seen was erroneously diagnosed clinically as acute articular rheumatism before observation of the blood picture. The patient had symmetrical tumors in the lower extremities which on x-ray examination showed periosteal changes simulating scurvy. Similar changes were present in nearly all the long bones.

The author mentions a case of leukemia reported by Pagniez in 1924 which showed evolution into chloroma following radiotherapy. He also quotes Feer as stating that chloroma is differentiated from leukemia by the generalized and extensive cell proliferation in the subperiosteal tissues and as calling attention to the existence of symmetrical tumors in chloroma, as well as to the acuteness and severity of the leukemia in mixed cases.

The author's case was not unlike the one cited and is suggestive of the intimate relationship between chloroma and leukemia. The importance of roentgen studies of the bones in leukemia is stressed.

A. MAYORAL, M.D.

Plasmocytoma of the Humerus. Mario Gómez Camejo and Antonio Ponce de León. Rev. med. cubana **53:** 783–793, September 1942.

A case of plasmocytoma of the left humerus is presented. The patient was a man of 55, who suffered a pathological fracture. Healing and disappearance of the tumor followed reduction and roentgen irradiation, but after a year and seven months there was a recurrence, with generalization. A. MAYORAL, M.D.

THE GENITO-URINARY TRACT

Calcification of Renal Tumors. George Austen, Jr. Am. J. Roentgenol. **49:** 580–586, May 1943.

Of 106 tumors verified by microscopic examination, 98 were malignant and 8 were benign. Only one benign tumor, a leiomyoma of the renal pelvis, showed abnormal calcification. Calcium deposits in the tumor tissue were demonstrated by roentgenologic and microscopic examination in 16 of the 98 malignant cases; 14 of these were carcinomas of the renal parenchyma, 1 was a papillary carcinoma of the renal pelvis, and 1 was a leiomyoliposarcoma of the renal capsule.

The calcification in renal tumors, as seen in the roentgenograms, assumed various patterns, not in themselves distinctive. In two instances the calcium deposits closely resembled those of renal tuberculosis. Calcified areas in the papillary carcinoma of the pelvis were at first mistaken for pelvic calculi.

Of the 14 carcinomas of the kidney parenchyma showing calcification, 9 were of the so-called "hypernephroma" type, 2 were papillary adenocarcinomas, 1 tubular or alveolar carcinoma, and 2 small-cell carcinomas. Fathological sections of these tumors showed multiple areas of hemorrhage, necrosis, and cystic degeneration. Calcium was always deposited in or about these areas. Although the rate of calcification is extremely variable and not proportionate to the degree of hemorrhage, it is of interest to note that in patients having calcified tumors the duration of symptoms from the onset to the time of treatment was definitely less than in those with non-calcified tumors.

While the survival rate in cases without calcification is approximately 30 per cent, for those with calcification it is 15.3 per cent. It would thus appear that the prognosis of cases with calcification is less favorable than of those without calcification.

CLARENCE E. WEAVER, M.D.

THE SPINAL CORD

Arachnoiditis (Diffuse Proliferative Leptomeningitis). Alex Blumstein and A. B. Baker. Ann. Int. Med. **18:** 809–824, May 1943.

Spinal arachnoiditis embraces both localized and disseminated forms, which explains the exceedingly varied and complex clinical picture. The onset is gradual without fever, and the course is invariably subacute or chronic. The disseminated type produces a syndrome of multiple involvement of the spinal nerve rootlets, both anterior and posterior, but predominantly posterior. *Pain is the most distinctive symptom,* usually commencing over one or more spinal segments, later becoming bilateral and spreading over a wide cutaneous area, sometimes with concomitant hyperesthesia or diminished sensation. This rootlet involvement is due to impingement by the proliferative leptomeningitis. A cyst later may produce signs and symptoms of compression simulating a true neoplasm.

Roentgenographically the *arrest of iodized oil at multiple levels* is the most important diagnostic aid. A subarachnoid block without xanthochromia or increased protein is a highly suggestive corroborative finding. The onset of arachnoiditis is much slower than in encephalomyeloradiculitis. In the latter condition, subarachnoid block is rare and the course is much more benign.

The treatment of choice is exploratory laminectomy to demonstrate the leptomeningeal adhesions. The most favorable non-surgical therapeutic measure is radiotherapy. The spine is cross-fired with high-voltage radiation at various levels, as indicated by the sensory disturbance. One or more series of treatments are given depending upon the response. An individual dose of 100–150 r (in air) is given fractionally, until a total of 800 r (in air) are administered. The recurrences of pain may be relieved by a repetition of the treatment. The outlook for therapeutic improvement,

however, after the process is long established, does not appear promising either with surgery or irradiation.

The pathological findings, grossly, consist of a definite thickening of the leptomeninges throughout the length of the spinal cord. In the more involved area, the membranes are opaque and completely obliterate the underlying structures. Frequent intermedullary cord changes are present due to vascular narrowing and occlusion caused by proliferative perivascular reactions.

In conclusion, four cases with autopsy findings are well presented, one in a child of seventeen months.

STEPHEN N. TAGER, M.D.

TECHNIC

An Investigation Into Some Practical Aspects of Roentgen-Ray Stereoptics. Part I. A Fallacy in the Current Practice of Stereoroentgenography. Part II. Single-Film Stereoroentgenograms—A New and Simple Method of Stereoroentgenography. Part III. A Device for Measuring Depth in Single-Film Stereoroentgenograms. Edward Klein, Milton Klein, Harold Klein, and Allen T. Newman. Am. J. Roentgenol. **49:** 682–690, May 1943.

In Part I the authors point out that the roentgenogram does not afford an image of an object but its shadow. They have established by trial and error that if the shadow displacement is greater than 3/8 inch the average person viewing two roentgenograms through a stereoscope at reading distance will not be able to fuse the two images to obtain a sense of depth. For this reason, the displacement of the tube must be varied in each case to insure that no more than this maximum deviation be produced. Use of the interpupillary distance displacement of the tube is incorrect. A formula for calculating the displacement of the tube is given.

Part II describes in detail a method for producing a stereoroentgenogram on a single film. When this is viewed through polarized spectacles, a tridimensional view is obtained. It can be viewed by more than one person at a time, or be projected on a screen and demonstrated to an audience .

In Part III a depth grid is described for the localization of foreign bodies and the determination of spatial relationships. A horizontal-vertical grid is marked in square centimeters by crossing wires. The depth grid is a long metal rod to which short spokes are attached at right angles and arranged spirally around it. These spokes are spaced at equal distances apart and numbered. The depth grid is attached to the horizontal vertical grid at right angles and in contact with the object to be radiographed. A stereoroentgenogram is made and viewed through polarizing spectacles. This enables the observer to compare the object-image with the calibrated depth-image, since both are in the same stereoptical field. A method of calculation of depth by means of a polarized ruler is also described. CLARENCE E. WEAVER, M.D.

INJURIOUS EFFECTS

Radiation Hazards During Roentgenoscopy. Thomas N. White, Dean B. Cowie, and Alfred A. de Lorimier. Am. J. Roentgenol. **49:** 639–652, May 1943.

The tests reported in this paper have been limited to conditions of horizontal roentgenoscopy, for it is believed that the greatest exposure is incurred thereby. The studies included the consideration of primary roentgen radiation escaping from conventional "ray-proof" roentgen tubes and the various components of secondary radiation, such as that emitted from fluoroscopic shutters, shutter housings, table tops, the patient (*i.e.*, phantom), and fluoroscopic screen. Measurements were made at a sufficiently large number of locations to permit the construction of isodose (strictly speaking, isodose per unit time or isointensity) curves, showing graphically the distribution of the secondary radiation.

In horizontal roentgenoscopy it is quite possible for the operator's legs to be nearly as close to he roentgen tube as were the ionization chambers in this test. At this distance undesirably large readings were obtained before supplementary absorbing material was added to the tube housing. Qualitative or quantitative testings were accomplished with no less than thirty-six different tubes or tube units. In every instance some escape of roentgen radiation was demonstrated—thus confirming the fact that the term "ray-proof" is in contradiction to the fundamental properties of roentgen rays. Large amounts of secondary radiation emanate from the irradiated side of lead shutters. Unless this is cut off by a cone extending from the tube housing to the shutters, or by some equivalent shield, there is likely to be over-exposure of the shins and feet of the roentgenoscopist.

The radiation emitted from the table top and screen is ordinarily affected by the patient, but wi h no patient present the operator may still receive appreciable amounts. The radiation from a very light table top, such as the United States Army litter, is much smaller than that from a conventional table top of wood veneer with metal frame.

In agreement with previous investigators, it appears that the secondary radiation from the patient is of preponderant importance. Metal side panels, such as are found on substantial totally enclosed tables of the "heavy-duty" type, are very effective in cutting off the back-scatter from the patient and table top. The amount of secondary radiation from the patient increases rapidly with the size of the beam. When the primary beam is allowed to permeate those tissues nearest to the roentgenoscopist without any intervening portion between the limits of the beam and the lateral wall, the radiant intensity is about twice that which obtains when even so little as 3 cm. of tissue intervenes to filter the rays. This fact should serve as a warning against prolonged viewing of the lateralmost tissues of a patient.

If a lead protective apron and gloves are worn by the operator to supplement well designed built-in protection, he can realize security against roentgen radiation exposure, except for very limited portions of his body such as his arms and shoulders. Except for these parts, the exposures can easily be kept well below conservative estimates of the tolerance dose; well below 0.04 r per hour, with the consideration of continuous roentgenoscopic activity, or less than 0.1 r for a strenuous ten-hour day of intermittent roentgenoscopy. With any of the present-day equipment, a considerable exposure is incurred by parts of the body such as the shoulders—a quantity of the order of ten times the accepted tolerance dose.

A comprehensive bibliography is appended.

CLARENCE E. WEAVER, M.D.

RADIOTHERAPY

NEOPLASMS

Roentgen Therapy of Malignant Neoplasms of the Skin. Ernesto Fonts Abreu. Rev. med. cubana **53:** 684–688, August 1942.

According to the author, 90 per cent of cutaneous epitheliomas, if not too far advanced, are curable. After mentioning the sensitivity peculiar to each type of epithelioma, he describes briefly his technic. The higher the kilovoltage, the greater the filtration employed and the greater the distance, resulting in increased penetration and improved clinical and cosmetic results. He has increased the distance formerly used—25 or 30 cm.—to 50 cm., and the filtration from 1 mm. copper to 2 mm. copper plus 1 mm. aluminum. With these factors he does not hesitate to give doses of 6,000 to 8,000 r. Treatment is given over areas of 1 to 3 sq. cm., 300 to 400 r daily except Sundays. In the more superficial lesions the dose is decreased to about 200 r. The total dose for small lesions varies between 4,000 and 6,000 r. According to the legends of the accompanying illustrations 200-kv. rays are used.

A. MAYORAL, M.D.

Treatment of Congenital Hemangioma of the Skin. G. S. Johnson and R. A. Light. Ann. Surg. **117:** 134–139, January 1943.

Hemangiomata have been classified by Watson and McCarthy (Surg., Gynec. & Obst. **71:** 569, 1940) into eight groups: (1) capillary hemangioma; (2) cavernous hemangioma; (3) angioblastic or hypertrophic hemangioma; (4) racemose hemangioma; (5) diffuse systemic hemangioma; (6) metastasizing hemangioma; (7) naevus venosus or port-wine stain; (8) hereditary hemorrhagic telangiectasis.

This article deals with capillary and cavernous types of hemangioma and their treatment with radon seed implantation. The technic employed by Brown and Byars has been followed, using one radon seed for each cubic centimeter of tissue. The content of the seeds varied from 0.25 to 1.0 millicurie, the amount of radon per seed depending on the size and location of the hemangioma. Seven cases are presented which were treated by this method. In 5 the lesions were on the face or lips and in 2 on the vulva. Pictures taken before and after treatment attest to the excellency of this method. In only one case was there any scarring, and this resulted from administering too large a dose for the type of hemangioma treated.

P. C. BRIEDE, M.D.

Treatment of Vascular Naevi by Radium Emanation. Desmond J. Riordan. Irish J. M. Sc., December 1942, pp. 626–630.

MacKee's classification of nevi as (1) naevus flammeus or port-wine stain, (2) naevus vasculosus or strawberry mark, and (3) angioma cavernosum, is ideal from the point of view of radiotherapy, since the three types vary definitely in their response to radiation. The best results are obtained with naevus vasculosus. Naevus cavernosum is less responsive but is more sensitive than naevus flammeus.

For the treatment of vascular nevi gold seeds with 0.5 mm. filtration for interstitial radiation and silver seeds with 0.9 mm. filtration for superficial application are used. For nevi on a flat surface, the radon is mounted on an elastoplast and felting applicator and then covered with elastoplast, delivering 2,000 roentgens in one week. This may be repeated at the end of one month and again at the end of three months. In such regions as the eyelids or lip, where the use of applicators is not practical, gold seeds are inserted temporarily or permanently, delivering 3,000 roentgens in one week; treatment not to be repeated. The author advises against the implantation of needles.

The distribution of radon on the applicator or in the tissues is according to a formula elaborated by Paterson and Parker in order to obtain homogeneous irradiation. A dosage chart is included.

HENRY K. TAYLOR, M.D.

Melanoepithelioma (Melanosarcoma, Melanocarcinoma, Malignant Melanoma) of the Extremities. W. H. Bickel, H. W. Meyerding, and A. C. Broders. Surg., Gynec. & Obst. **76:** 570–576, May 1943.

The authors analyze 107 proved cases of melanoepithelioma of the extremities seen in the Mayo Clinic in a 24-year period. The age span was twelve to seventy-six years, over 50 per cent of the patients being between forty and sixty. Lower limb lesions constituted 76.7 per cent of the total. Obvious metastases were noted initially in 38.3 per cent, and these by way of all possible routes. The observation is made that primary or metastatic lesions may or may not be pigmented. Symptomatology is considered in detail.

Treatment results were as follows. Excision with or without irradiation produced 29.8 per cent five-year survivals from initiation of treatment. In many of these cases the lesions were early or small. Amputation with or without radiation, usually done in late or advanced lesions, yielded 21.1 per cent five-year survivals. Irradiation only was employed in just 15 cases, of which 11 had had surgery elsewhere; all of this group died in less than three years. The authors advise wide excision, with removal of regional lymph nodes, or amputation at the first diagnosis. Exceptions should be only those lesions in which no enlargement is discovered, and in these wide local excision is indicated.

This is an excellent and substantial paper, but treatment analysis has been from a surgical point of view, so that a real comparison between the results of surgery and radiotherapy cannot be made.

EDWIN L. LAME, M.D.

Discussion on the Value of Irradiation in Association with Surgery in the Treatment of Carcinoma of the Breast. Stanford Cade *et al.* Proc. Roy. Soc. Med. **36:** 237–242, March 1943.

Cancer of the breast may be classified according to (1) *the histological structure* as papillary, intraduct, adenocarcinoma, scirrhous, or medullary, or according to (2) *the clinical type* as scirrhous, encephaloid, duct carcinoma, atrophic scirrhous, or Paget's disease of the nipple. These classifications aid in arriving at a prognosis, but of all the prognostic factors, extent is the most important. With this as a basis, the author uses the following classification: (1) tumor of the breast only; (2) tumor of the breast plus

skin changes and/or axillary nodes; (3) stage two and/or supraclavicular or contralateral axillary nodes or fixation to the pectoral fascia; (4) visceral or skeletal metastases (regardless of local extent).

Three sets of statistics for surgically treated cases are quoted. The most favorable are those of G. Gordon-Taylor, following radical mastectomy. These show 85.4 per cent three-year survivals for first stage cases; 46.8 per cent for the second, and 10.1 per cent for the third stage. The ten-year survival rate for this group was 84.07 per cent for the first stage; 29.4 per cent for the second; 6.5 per cent for the third.

The statistics of Keynes for interstitial radiation therapy are also quoted. The net survival rates were: at the end of three years, for the first stage 83.5 per cent, for the second stage 51.2 per cent, and for the third stage 31.4 per cent; and at the end of five years 71.4 per cent for stage one, 29.3 per cent for stage two, and 23.6 per cent for stage three. The author's own five-year survival figures in 213 cases after radium alone, or radium and surgery, are 87.7 per cent for the first stage; 29.6 per cent for the second stage; 25.4 per cent for the third stage.

An evaluation of the figures shows that cases in stage one do very well with any type of treatment. With surgery alone there is a 90 per cent mortality in stage three at the end of three years, while the combination of radium and surgery has increased the survival rate of stage three to 25 per cent at the end of five years.

The author concludes that in cancer of the breast a combination of surgery and radiotherapy is the treatment of choice. Skilled radiation therapy is no longer an *auxiliary* method, but of equal and, in some cases, of *greater* importance than surgery.

Dr. R. McWhirter, continuing the discussion, stated that the five-year survival rate in cases of carcinoma of the breast referred to large general hospitals is probably not more than 20 per cent with surgery alone, failure to eradicate the disease being due either to distant metastases, or failure to remove all malignant cells, or both. It is in the cases in which malignant cells are left at the operative site that irradiation may convert a potential failure into success.

In order to determine the value of postoperative radiation therapy, an investigation was undertaken in co-operation with the surgical staff of the Royal Infirmary in Edinburgh. The cases were divided into 4 groups according to the extent of disease. This classification differs slightly from that of Cade. The first 3 groups were in turn divided into 2 groups: one treated with surgery alone and the second by a combination of surgery and irradiation. Adequate postoperative radiation therapy consisted of a minimum dose of not less than 3,500 r, more often 4,500 r, in four weeks to an area including the supraclavicular region, the whole length of the axillary chain of nodes, and the chest wall on the affected side. The results indicated that a combination of surgery and postoperative radiation therapy yields better results than surgery alone.

Mr. J. Jackson Richmond also presented evidence which revealed the improved results obtained by a combination of irradiation and radical mastectomy. He recommended preoperative as well as postoperative irradiation. A small number of histologically Grade I cases can be treated safely by surgery alone.

HENRY K. TAYLOR, M.D.

Roentgen Treatment of Cancer of the Esophagus. D. W. Smithers, J. R. Clarkson, and J. A. Strong, Am. J. Roentgenol. **41:** 606–634, May 1943.

In the introduction to this paper Smithers summarizes the reasons for failure of treatment of cancer of the esophagus due to the nature of the disease and the difficulties associated with the various therapeutic methods, *viz.*, surgery, teleradium, interstitial radium or radon, radium bougie, and roentgen irradiation. Roentgen treatment has much to recommend it, for it is the most effective method of securing palliation and at the same time causes the least discomfort.

In his account of roentgen treatment of esophageal cancer at the Royal Cancer Hospital (London) Smithers divides the cases according to the site of the tumor as follows: (1) postcricoid tumors and tumors of the cervical esophagus; (2) tumors of the thoracic esophagus; (3) tumors of the abdominal esophagus and of the fundus of the stomach involving the esophagus.

To obtain an adequate tumor dose, multiple fields must be used, and it is clear that long narrow fields will give the best distribution. In tumors of the thoracic esophagus six fields are employed, arranged in three sets of directly opposing pairs: an anteroposterior pair measuring 15 × 6 cm. each and two oblique pairs measuring 15 × 4 cm. each, the fields being so arranged that the center of each anterior oblique field is 7.0 cm. from the mid-line and the central rays from all six fields meet at the center of the tumor. The tumor is localized by aligning it between two points on the surface in several planes, using the fluoroscopic screen. A cross-section drawing of the patient's chest is then made with the aid of a special apparatus. The skin marks made at fluoroscopy are reproduced on the drawing and joined by lines representing the central axis of the beams of radiation. This cross-section is used to determine the tumor dose due to a combination of the six fields selected. The patient is treated in the sitting position, with a specially designed apparatus for maintenance of position. A treatment is given daily to all six fields for five to seven weeks, usually with the following factors: 400 kv. peak; filtration 0.22 mm. Sn with 1.7 mm. Al added, the inherent filtration being equivalent to 2.0 mm. Cu, the half-value layer of the radiation being 3.7 mm. Cu; focal skin distance 80 cm.; dosage rate on the skin surface about 10 r/min. and at the tumor center about 3 r/min. The tumor dose is planned to be between 6,000 and 7,000 r in six weeks. In the average case this means a daily dose per field of 100 r. Any air spaces between portions of the applicator and the chest wall are filled with rice bags. The patient is examined a week or two after cessation of the treatment, by barium meal. Six to eight weeks later esophagoscopy may be performed. If there is a tendency to fibrotic constriction, careful and repeated dilatation should be undertaken.

In postcricoid tumors of the pharynx and tumors of the cervical esophagus a directly opposing anteroposterior pair of fields measuring 10 × 6 cm. is arranged. Two 7 cm. diameter circular fields are used on either side of the neck in the same anteroposterior plane as the tumor but angled downward and inward.

In tumors of the abdominal esophagus and of the cardiac end of the stomach involving the esophagus six fields measuring 10 × 6 cm. arranged in three pairs are used.

Of 44 patients with esophageal carcinoma treated by roentgen rays from 1936 to 1939, 30 obtained some relief of symptoms and 11 complete relief. Of 15 patients treated during the first half of 1940, 7 have obtained some relief and 7 are symptom-free. In no case has fibrosis of the lungs developed. Skin reactions have been mild erythemas only. Of the series treated in 1936–39, 6 were alive at the time of the report, 1 after four years. Of those who died, 8 lived a year or more after treatment and 1 more than two years.

Part II of this paper, by Clarkson and Strong, is devoted to a detailed account of the physical measurement of the volume roentgen-ray dosage distribution due to elongated fields. The measurements of dosage were made in a water phantom of dimensions 43.5 × 42.5 × 110 cm.; 140 per cent isodose surfaces were worked out for 200 kv., 1.35 mm. Cu half value layer, 80 cm. focus-skin distance; also, for 400 kv., 3.7 mm. half value layer, 80 cm. focus skin distance. It was found that the surface obtained at 200 kv. is both shorter and narrower than for the more penetrating radiation and that the points of maximum dose tend to lie toward the front of the esophagus.

Tables, charts, and roentgenograms illustrate this paper. CLARENCE E. WEAVER, M.D.

Diagnosis and Treatment of Vesical Tumors. Ricardo Portilla. Rev. med. cubana **53:** 689–694, August 1942.

Portilla divided his investigation of tumors of the bladder into two parts, clinical and mechanical. He stresses the importance of the first but goes into greater detail concerning the second, which includes cystoscopy and roentgenography. After discussing the possible findings, he enumerates some of the pitfalls of diagnosis.

In treatment the general condition of the patient and superimposed infection, if present, call for first attention, to be followed by therapy aimed at destruction of the tumor. For small pedunculated tumors the author advises electrocoagulation or resection with the MacCarthy instrument. For small sessile lesions not over 3 cm. in diameter, located near the trigone, implantation of radon seeds in combination with electrocoagulation is recommended. In large pedunculated growths or multiple tumors, cystostomy with electrocoagulation is indicated, associated with radon implantation at the base. For sessile tumors or infiltrating lesions not involving the trigone, partial cystectomy is the method of choice. If the trigone is involved, total cystectomy should be done. In the presence of multiple papillomata and in advanced cases radiotherapy is used with good results for the relief of symptoms. A. MAYORAL, M.D.

Leukemia: Relative Incidence of Its Various Forms and Their Response to Radiation Therapy. Frank H. Bethell. Ann. Int. Med. **18:** 757–771, May 1943.

A series of 495 cases of leukemia, examined at the Simpson Memorial Hospital, Ann Arbor, Michigan, from July 1, 1927, to Dec. 31, 1941, is presented in tabular form, with respect to the sex and age of the patients and the relative frequency of various types. Three main forms are recognized: the *lymphogenous* (216 cases, or 43.6 per cent of the total); the *myelogenous* (239 cases, or 48.3 per cent); the *histogenous* (40 cases, or 8.1 per cent). The last is characterized by generalized proliferation of cells of reticulo-endothelial origin. Monocytes are commonly found in the circulating blood of such patients.

A possible explanation for the progressive increase in the diagnosis of leukemia lies in the current use of sternal marrow examination in practically all suspected primary blood disorders.

The indications for radiation therapy in the myelogenous group (myelocytic and myelomonocytic leukemias) are symptoms of anemia, increased metabolism, pressure due to splenomegaly, and pain in or referred from the splenic area. The chronic forms of the disease give the best response and the myelocytic and lymphocytic varieties are most responsive to treatment. The degree of improvement, the duration of remission, and the elapsed time before occurrence of a refractory state cannot be foreseen in any individual case.

The plan of therapy has involved an intensive short course of treatments with exposure limited usually to the splenic area in cases of myelocytic and chronic myelomonocytic leukemia. The factors used are 200 kv., 25 ma., 50 cm. F.S.D., 0.5 mm. Cu plus 1.0 mm. Al filter, with a field of 100–150 sq. cm. A skin dose of 100 to 200 r is administered over the anterior, lateral, and posterior surfaces of the splenic area. The treatments may be given on consecutive days, preferably as rapidly as possible, except that not more than one field is treated during a 24-hour period.

Particular emphasis is placed on the differentiation of monocytic leukemia as related to the myeloblast and that form believed to derive from an undifferentiated reticulum cell or histioblast.

Three illustrative cases are mentioned, with excellent illustrations of pertinent hematologic data.

STEPHEN N. TAGER, M.D.

NON-NEOPLASTIC DISEASE

Clinical Classification and X-Ray Therapy in Acute Pulmonary Infections. R. C. Curtis. Texas State J. Med. **38:** 722–723, April 1943.

Among 150 cases of pneumonia treated with roentgen rays there were 5 deaths, a mortality rate of 3.33 per cent. Half of the patients also received sulfa drugs, and 3 of the fatalities were in this group. An earlier report (Powell: J. A. M. A. **110:** 19–22, 1938. Abst. in Radiology **32:** 382, 1939) from the same institution included 134 cases treated with x-rays and no sulfa drugs, with 9 deaths. The author combines both groups, making a total of 284 cases with 14 deaths, a mortality rate of 4.9 per cent. The 75 patients receiving chemotherapy showed no untoward effects from the combined treatment. The factors now used are 185 kv., 0.5 mm. Cu and 1.0 mm. Al filtration, 50 cm. distance, 20 × 20 cm. field, 250 roentgens per dose at a rate of 25 r/m.

The favorable results to be expected are relief of labored breathing and pain and lowering of the respiration rate, pulse rate, temperature, and white count. The treatment is not used in the tuberculous. Complications were infrequent in the author's series. In his group of 150 cases, 64, or 42.6 per cent, required but one treatment, and the crisis occurred in forty-eight hours; 46, or 20 per cent, required two treatments, the crisis occurring in seventy-two hours; 35 required three or four treatments and their recovery was slower. Of 35 patients admitted to the hospital on the fifth to the fifteenth day, 5 had lung abscesses,

all of which had ruptured into a bronchus with spontaneous drainage and recovery. Three patients had pleural effusions, which resolved in every instance.

HENRY K. TAYLOR, M.D.

Roentgen Therapy of "Virus" Pneumonia. Albert Oppenheimer. Am. J. Roentgenol. **49:** 635–638, May 1943.

For the treatment of virus pneumonia, the following factors were used: 130 to 150 kv., according to the size of the chest and the thickness of the skin and muscles; 30 ma.; 0.5 mm. Cu plus 1.0 mm. Al filtration; 50 cm. anode-skin distance; an average dose of 50 r (measured in air) through portals covering the involved parts of the lungs, usually 20 × 30 cm. The amount of radiation applied should increase with the duration of the inflammation (up to 90 r in adults). As a general rule, a single treatment was sufficient to bring about a return of temperature to normal within sixteen hours, as well as a considerable diminution of the cough and distress, in patients treated within a few days after the onset of symptoms. When treatment was begun after the disease had lasted for over a week, a second treatment, sometimes followed by a third after forty-eight hours, was necessary to obtain relief and bring the temperature to normal. Patients treated after termination of the febrile stage because of persistent cough at night, associated with fatigue and inability to resume normal occupation, were free of symptoms after three or four doses of 90 r in the course of two weeks.

Fifty-six cases were treated by the author. Only 11 patients were considered as not cured; 8 of these had been sick over fourteen days and 3 had had the disease six to fourteen days. The conclusion is reached that "it would seem to be evident that roentgen therapy helps to shorten the duration of the disease materially." Heavy dosage in the early stages should be avoided.

CLARENCE E. WEAVER, M.D.

TECHNIC

Discussion on the Technique of Radiotherapy. B. W. Windeyer *et al.* Proc. Roy. Soc. Med. **36:** 261–270, March 1943.

The subject of irradiation in laryngology is discussed in a general way by Windeyer, who mentions the indications for multiple small dose, single massive dose, and fractionated technics, and outlines the general plan of treatment.

Constance Wood describes the radium bomb designed at the Radiotherapeutic Research Unit of the Medical Research Council. The apparatus has devices for localizing and accurately directing the rays and means for determining the number of roentgens delivered per hour at any given part. In treating carcinoma of the oral cavity and pharynx, the primary growth is irradiated through its lymphatic drainage in the neck. The details of the technic are illustrated in the treatment of a new growth on the posterior wall of the oropharynx, using 4 ports. The best results were obtained when 6,000 to 7,000 roentgens were delivered to the lesion in 42 days, with two treatments of 20 minutes each daily.

Ralston Paterson divides pharyngeal and laryngeal new growths into (1) squamous-cell carcinoma and (2) reticulo-endothelial new growths. Squamous-cell cancer, which is more frequent, requires precise localization because the fundamental need is to irradiate the smallest possible volume enclosing the tumor. The aim is to give as much radiation as will be tolerated safely. With a smaller field, a greater dosage can be delivered. Reticulo-endothelial growths, as lymphosarcoma, lymphoepithelioma, reticulum-cell sarcoma, round-cell sarcoma, etc., are highly radiosensitive. Large fields are used for irradiation of these growths. Good results are usually obtained if radical treatment, to the limits of tolerance, is administered before dissemination.

HENRY K. TAYLOR, M.D.

EXPERIMENTAL STUDIES

Studies on the Indirect Effect of Roentgen Rays in Single and Parabiotic Mice. W. A. Barnes and O. B. Furth. Am. J. Roentgenol. **49:** 662–681, May 1943.

The effects produced in exposed and non-exposed bone marrow of mice receiving 800, 2,000, or 6,000 r to the entire body except one leg varied but little qualitatively. The larger the dose, the earlier was the decrease of hematopoietic cells in the directly irradiated marrow noted. There was capillary dilatation in the unexposed marrow from three to five days after irradiation, but no decrease in the number of hematopoietic cells, except perhaps one to three days after 6,000 r. These experiments show that in mice after a single exposure (with one leg shielded) to as much as 6,000 r, there are no conspicuous destructive effects in the non-exposed marrow after from three to five days. The significant changes in lymph nodes several hours after irradiation, slight in the shielded and marked in the exposed nodes, consisted of pyknosis and fragmentation of the nuclei of the lymphocytes. The authors were able to produce similar changes in the lymph nodes and bone marrow in mice burned by actual cautery over the abdomen and chest. The changes are, therefore, not specific for indirect effects of irradiation. The magnitude of the indirect effect of irradiation is dependent, at least in part, on the volume of tissue exposed and not alone on the dose of roentgen rays.

The changes occurring in the blood-forming organs of a parabiont directly exposed to 800, 3,200, or to 6,000 r are similar but quantitatively less than those occurring in a single mouse similarly irradiated. After irradiation of its twin with 800 or 3,200 r, the non-irradiated parabiont shows no destructive changes in the blood-forming organs one to eleven days later. However, seven hours after its twin received 6,000 r, the non-irradiated parabiont showed pyknosis and fragmentation of nuclei of lymphoid cells. In spite of the initial damage, the non-irradiated mouse recovered almost completely within three days, whereas the irradiated twin showed persistent damage consisting of aplasia of bone marrow and marked decrease of cellular elements of spleen and lymph nodes.

Experiments showed that when one member of a pair of parabiotic mice was irradiated with from 450 to 1,000 r there was leukopenia in the irradiated para-

biont. There was no leukopenia in the non-irradiated parabiont after exposure of its twin to 450 r. When its twin received 800 or 1,000 r, there was a moderate to marked drop in the leukocyte level of the non-irradiated parabiotic animal. The reduction of the number of leukocytes in the irradiated parabiont was less marked than in an irradiated single control and the return toward normal occurred sooner. Differential counts show that the decreased leukocyte level in the irradiated twin is due to a fall in both myeloid and lymphoid cells, more especially in the latter. The leukopenia in the non-irradiated twin similarly is due largely to a lymphopenia. This can be explained either by passage of lymphocytes from the shielded to the irradiated animal or by transfer of a noxious agent from the irradiated to the shielded twin.

These experiments suggest the possibility that an animal united to another by parabiosis might survive larger doses of roentgen rays. A single mouse almost invariably dies following exposure to 1,000 r, but if joined to another mouse by parabiosis it may survive. Parabiosis diminishes the deleterious effects of irradiation.

CLARENCE E. WEAVER, M.D.

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